(2)

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

THE USE OF INTERNATIONAL STANDARDS ORGANIZATION ISO 9000 QUALITY ASSURANCE STANDARDS IN PLACE OF MILITARY STANDARDS

by

Stanley M. Beckerdite

June 1992

Thesis Co-Advisor: Rodney F. Matsushima
Thesis Co-Advisor: Stephen Zirschky

Approved for public release; distribution is unlimited

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b. OFFICE SYMBOL (*If applicable*) Code AS	7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c. ADDRESS (*City, State, and ZIP Code*) Monterey, CA 93943-5000	7b. ADDRESS (*City, State, and ZIP Code*) Monterey, CA 93943-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (*If applicable*)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (*City, State, and ZIP Code*)	10. SOURCE OF FUNDING NUMBERS Program Element No. / Project No / Task No / Work Unit Accession Number

11. TITLE (*Include Security Classification*)
THE USE OF INTERNATIONAL STANDARDS ORGANIZATION ISO 9000 QUALITY ASSURANCE STANDARDS IN PLACE OF MILITARY STANDARDS

12. PERSONAL AUTHOR(S) Beckerdite, Stanley M.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (*year, month, day*)	15. PAGE COUNT
Master's Thesis	From To	June 1992	150

16. SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17. COSATI CODES			18. SUBJECT TERMS (*continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUBGROUP	Quality Assurance, ISO 9000, MIL-Q-9858A, Contracts

19. ABSTRACT (*continue on reverse if necessary and identify by block number*)

The implementation of quality standards within the European Community by the creation of International Quality Standards 9000 is another step toward development of a global marketplace. It is in the interests of DoD to support this trend in order to help maintain the defense industrial base.

The first part of this study performs a comparison of DoD quality standards to the ISO 9000 Standards. The second part of the study consistis of a survey of U.S. firms that have become ISO 9000 registered. This survey is intended to provide an assessment of the current movement within the defense industrial base toward adoption of ISO 9000 Standards. The survey also attempts to identify potential implementation issues relating to adoption of ISO 9000 Standards in place of military standards. It is concluded that DoD should implement ISO 9000 and that the impact of this implementation will be favorable.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION	
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS REPORT ☐ DTIC USERS	UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL Rodney F. Matsushima	22b. TELEPHONE (*Include Area code*) (408) 646-2052	22c. OFFICE SYMBOL Code 54 SX

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted; All other editions are obsolete — SECURITY CLASSIFICATION OF THIS PAGE: Unclassified

Approved for public release; distribution is unlimited.

The Use of International Standards Organization
ISO 9000 Quality Assurance Standards
in Place of Military Standards

by

Stanley M. Beckerdite
Lieutenant Commander, United States Navy
M.B.A., University of Wisconsin-Milwaukee, 1981
B.B.A., University of Wisconsin-Whitewater, 1975

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1992

Author: Stanley M. Beckerdite
Stanley M. Beckerdite

Approved by: Rodney F Matsushima
Rodney F. Matsushima, Thesis Co-Advisor

Stephen Zirschky
Stephen Zirschky, Thesis Co-Advisor

David R. Wipple, Chairman
Department of Administrative Sciences

ABSTRACT

The implementation of quality standards within the European Community by the creation of International Quality Standards 9000 is another step toward development of a global marketplace. It is in the interests of DoD to support this trend in order to help maintain the defense industrial base.

The first part of this study performs a comparison of DoD quality standards to the ISO 9000 Standards. The second part of the study consists of a survey of U.S. firms that have become ISO 9000 registered. This survey is intended to provide an assessment of the current movement within the defense industrial base toward adoption of ISO 9000 Standards. The survey also attempts to identify potential implementation issues relating to adoption of ISO 9000 Standards in place of military standards. It is concluded that DoD should implement ISO 9000 and that the impact of this implementation will be favorable.

TABLE OF CONTENTS

I. PURPOSE/INTRODUCTION

A. GENERAL INFORMATION

The primary standards cited in Department of Defense (DoD) contracts for quality assurance programs are Military Specifications MIL-Q-9858A (MIL-Q) and MIL-I-45208A (MIL-I).

The emergence of a global marketplace has led to the creation of quality control standards that will apply to this new marketplace. The International Standards Organization (ISO) has developed the ISO 9000 Quality Management and Quality Assurance Standards(ISO 9000). These new international standards are applicable to countries in Europe that will form the European Community (EC) in 1992.

B. OBJECTIVE OF THE RESEARCH

The purpose of this study is to determine if DoD should enact the implementation of ISO 9000 standards in weapon systems contracts. The primary research question is: Should ISO 9000 be implemented within DoD and the Defense Industrial Base, and when implemented how will it affect DoD contracting? In addition to the primary research question, the following subsidiary research questions will also be addressed:

1. What is ISO 9000?

2. What are the similarities and differences between ISO 9000 standards and Military Standards (MIL-Q-9858A and MIL-I-45208)?

3. What is the policy of DoD with regards to ISO 9000?

4. Of companies within the Defense Industrial Base that have completed ISO 9000 certification, what are the anticipated benefits?

5. Should ISO 9000 be recommended for implementation within DoD and the Defense Industrial Base, and if so, what action must be taken to accomplish this objective?

C. SCOPE AND LIMITATIONS OF THE STUDY

This study involves a detailed assessment of ISO 9000 standards as compared to the current Military Standards. The study involves gathering information from Government and commercial organizations to determine the current state of knowledge as well as institutional forces that either support or reject the implementation of ISO 9000 in place of Military Standards. The study is not limited as to size of defense contractors, or to a specific type of industry; suggested recommendations for implementation are applicable to the entire Defense Industrial Base.

D. METHODOLOGY

The research data were collected through an extensive literature search and by telephone interviews.

The literature search, comprising professional journal articles and current regulations and directives, was made through the Naval Postgraduate School Library, the Defense Logistics Studies Information Exchange (DLSIE), attendance at

an ISO 9000 workshop sponsored by the University of Wisconsin-Whitewater, and from several DoD offices responsible for Quality Assurance. This survey provides a background of information that defines and describes both ISO 9000 standards and MIL-STDS that apply to quality assurance systems.

The researcher completed 25 telephone interviews with managers and directors of contractor quality assurance programs. Appendix A provides a listing of the companies contacted. The interviews were all held on a nonattribution basis in order to obtain candid responses and honest evaluations of current and proposed implementation plans for ISO 9000 standards. The interviews were conducted by telephone to allow the researcher to obtain and explore information from people who had extensive experience in implementing ISO 9000 standards.

E. ORGANIZATION OF THE STUDY

Chapter II provides background information and descriptions of ISO 9000 standards and Military Quality Assurance standards.

Chapter III compares the underlying philosophies of ISO 9000 to Military Standards and draws detailed comparisons of the two sets of standards.

Chapter IV presents data and a description of methods used to collect the information. This chapter also includes an analysis and interpretation of the data.

Chapter V contains conclusions and recommendations regarding the implementation of ISO 9000 as well as areas for further research. While answering research questions, this final chapter also discusses the conclusions based upon research data, makes specific recommendations resulting from the research effort, and suggests possible areas for further research.

II. BACKGROUND

A. INTRODUCTION

The decline in DoD procurement dollars has led many companies to search for new markets overseas. As this expansion into the international market occurs, it is logical that DoD contractors will argue for increased standardization between current United States standards and international standards used in contracting.

One of the primary areas of interest for standardization lies in Quality Assurance. The area of quality control should be one in which the buyer and seller agree on an acceptable method, since standardization of quality assurance systems across international boundaries has the potential of significantly reducing quality inspection costs. These standardization agreements create special problems but hold great potential when viewed from the standpoint of international trade. In order to achieve the desired quality of products between competing producers, adherence to international standards gives the purchaser an opportunity to reduce duplication of quality inspections without sacrificing the quality of the end product. Additionally, an international standard that is understood and acceptable to

the buyer reduces the complexity of assessing a potential supplier's quality assurance program.

The creation of the European Economic Community in 1992 has led to the formation of international quality standards (ISO 9000 standards). This standardization of quality assurance in Europe will certainly impact U.S. firms and the DoD industrial base. The acceptance of ISO 9000 standards for use in DoD contracts has already been proposed within DoD. The next step in implementing ISO 9000 becomes one of educating and familiarizing both industry and Government personnel in the use of these standards.

The motivation to accept international standards is based on the need for market expansion. As companies expand their foreign sales, they will be forced to adopt ISO 9000 in order to remain competitive in overseas markets. The use of one quality standard for both DoD and international sales promises reduced administrative and maintenance costs relating to quality assurance programs.

The next section of this study will provide a broad background in both ISO and MIL-STD Quality Assurance standards.

B. ISO 9000 STANDARDS

The ISO 9000 standards comprise five (5) separate documents. A listing, accompanied by a brief description, is as follows:[Ref 1:p.23]

- ISO 8402. Quality, Vocabulary. This is simply a reference document that defines terms used in ISO 9000 standards.

- ISO 9001. Quality Systems. Model for quality assurance in design/development, production, installation and servicing. This is a specific model for companies that have all phases of the manufacturing process from design to final product, and is the most comprehensive of the ISO standards.

- ISO 9002. Quality Systems. Model for quality assurance in production and installation. This is a specific model for manufacturing companies that have all phases of manufacture except design of the product.

- ISO 9003. Quality Systems. Model for quality assurance in final inspection and test. This gives specifics for end-item inspection procedures.

- ISO 9004. Quality Management and Quality System Elements Guidelines. This is another reference document that explains the philosophy and underlying purpose of ISO 9000.

The ISO 9000 standards are based on an approach to quality assurance that models itself along Total Quality Management (TQM) principles. The aim of the standards was summarized by Trevor Davis from the quality management group at Coopers & Lybrand Deloitte, as follows:[Ref 1:p.25]

- to increase customer confidence in the company, by providing a common framework across Europe (and the world);

- to move from a system of inspection to one of quality management;

- to remove the need for multiple assessments of suppliers;

- to gain management commitment;to link quality to cost effectiveness; and

- to give customers what they have asked for.

The above summary highlights some of the main themes that run through the ISO 9000 standards. Many of the principles listed clearly reflect the TQM approach.

Each of the ISO 9000 documents covers different phases of the quality assurance area, and each document is briefly described below.

1. ISO 9004, Quality Management: Specification for Design/Development, Production, Installation and Servicing.

The document that gives broad guidelines and amplifies the other four ISO documents is ISO 9004. The ISO 9000 standards were written with two applications in mind. The first was the creation of guidance for companies to use in developing their quality assurance organizations; the second, a program that would satisfy the contractual quality requirements dictated by customers.[Ref 2:p.2]

The ISO 9004 document provides guidance in creating an internal quality assurance organization. The document begins with a list of definitions which incorporates ISO 8402 definitions into the ISO 9000 standards. ISO 9004 also outlines concepts regarding principles of Quality Assurance and the proper selection of ISO 9001, 9002 or 9003 for specific applications. ISO 9004 concludes by bridging the internal/external applications of the ISO 9000 standards. It clearly calls for the use of customized versions of the 9001,

9002, and 9003 documents. The ISO 9000 documents state that it is not the intention of ISO to force suppliers into the acceptance of one standardized quality assurance organization. Rather, the standards are meant to assure both the supplier and customer that a product/service is being provided that will satisfy contractual requirements for quality.

2. ISO 9001, Quality Systems: Specification for Design/Development, Production, Installation and Servicing.

This portion of ISO 9000 is intended "for use when conformance to specified requirements is to be assured by the supplier during several stages which may include design/ development, production, installation and servicing."[Ref 4:p.1] Paragraph 4 of this portion of ISO 9000 gives an outline of a quality assurance program that takes the following form:

- 4.1 Management responsibility
- 4.2 Quality system
- 4.3 Contract review
- 4.4 Design control
- 4.5 Document control
- 4.6 Purchasing
- 4.7 Purchaser supplied product
- 4.8 Product identification and traceability
- 4.9 Process control

- 4.10 Inspection and testing
- 4.11 Inspection, measuring and test equipment
- 4.12 Inspection and test status
- 4.13 Control of nonconforming product
- 4.14 Corrective action
- 4.15 Handling, storage, packaging and delivery
- 4.16 Quality records
- 4.17 Internal quality audits
- 4.18 Training
- 4.19 Servicing
- 4.20 Statistical techniques

The ISO 9001 document is written in simple, easy-to-understand language, and many of the paragraphs listed above are subdivided into parts composed of one sentence. As an example, paragraph 4.15.2, "Handling:"

> The supplier shall provide methods and means of handling that prevent damage or deterioration.[Ref 3:p.6]

Numerous other examples can be seen in Appendix B which provides a comparison of ISO 9001 to MIL-Q-9858A. It should be noted that Appendix B lists ISO 9001 paragraphs in the right-hand column of the appendix, and the entire appendix is structured using the format of ISO 9001.

ISO 9001 is a model for a quality assurance organization that is engaged in design, development and production of a complex product requiring conformance to buyer-directed specifications. It does not give a micro-

management approach to the quality program being used by the supplier. Suppliers are free to implement the model in a way that best suits their production process. Yet the model does cover all the areas of a sound quality assurance program.

ISO 9001 is meant to be a model, designed for systems procurements that include the design of the end product by the manufacturer. It covers all aspects of producing a complete weapon system as specified by a buyer. The supplier is expected to conform to buyer specifications in several phases of the procurement. The ISO 9002 standard takes the systems approach and reduces it to an established product line.

3. ISO 9002, Quality Systems: Specification for Production and Installation.

The functions of design/development and servicing have been removed from ISO 9001 in order to produce the ISO 9002 document. This portion of ISO 9000 is intended "for use when conformance to specified requirements is to be assured by the supplier during production and installation."[Ref 4:1] The outline of the model in this document is composed along the same lines as shown in paragraph B above, with the removal of subparagraphs Design Control and Servicing. The ISO 9002 document is very similar in detail to ISO 9001, except it assumes a mature product with a design not subject to much change.

The ISO 9003 document takes the ISO 9002 and reduces it even further to where it becomes appropriate for use in established production lines that are built to producer specifications.

4. ISO 9003, Quality Systems: Specification for Final Inspection and Test.

This portion of ISO 9000 is intended "for use when conformance to specified requirements is to be assured by the supplier solely at final inspection and test."[Ref 5:p.1] Paragraph 4 of ISO 9003 outlines a quality assurance program as follows:

- 4.1 Management responsibility
- 4.2 Quality system
- 4.3 Document control
- 4.4 Product identification
- 4.5 Inspection and testing
- 4.6 Inspection, measuring and test equipment
- 4.7 Inspection and test status
- 4.8 Control of nonconforming product
- 4.9 Handling, storage, packaging and delivery
- 4.10 Quality records
- 4.11 Training
- 4.12 Statistical techniques

ISO 9003 obviously applies to mass production of supplier-specified products. In addition to the deletion of subparagraphs in paragraph 4 that relate to process inspection, the remainder of ISO 9003 has been modified to reflect a less intrusive quality assurance program regarding purchasing and process control. Using ISO 9003 puts very little burden on the supplier other than final inspection and test requirements.

C. DOD MILITARY QUALITY STANDARDS

The primary standards cited in Department of Defense (DoD) contracts concerning quality assurance programs are Military Specifications MIL-Q-9858A (MIL-Q) and MIL-I-45208A (MIL-I). A brief overview of the guiding philosophy for each of these specifications is presented below. This overview is intended to provide background for comparison of these DoD specifications to the ISO 9000 standards; the comparison will be done in the next section of this study.

1. MIL-Q-9858A: Quality Program Requirements.

This specification is structured from the standpoint of the Government. It directs suppliers on what they shall consider when conforming to this specification, and it requires approval of the company's quality program by the Government. The following two paragraphs provide a perspective for this specification:

1.2 Contractual Intent. This specification requires the establishment of a quality program by the contractor to assure compliance with the requirements of the contract. The program and procedures used to implement this specification shall be developed by the contractor. The quality program, including procedures, processes and product shall be documented and shall be subject to review by the Government Representative. The quality program is subject to the disapproval of the Government Representative whenever the contractor's procedures do not accomplish their objectives. The Government, at its option, may furnish written notice of the acceptability of the contractor's quality program.

1.3 Summary. An effective and economical quality program, planned and developed in consonance with the contractor's other administrative and technical programs, is required by this specification. Design of the program shall be based upon consideration of the technical and manufacturing aspects of production and related engineering design and materials. The program shall assure adequate quality throughout all areas of contract performance; for example, design, development, fabrication, processing, assembly, inspection, test, maintenance, packaging, shipping, storage and site installation.

These two examples illustrate the somewhat negative writing style and all-encompassing nature of MIL-Q-9858A specification. There are "laundry lists" throughout the specification written to cover all possible eventualities that might affect the quality program of a company engaged in complex production processes. MIL-Q-9858A (which is reproduced on the left-hand side of Appendix B) offers a legalistic framework in much of its phrasing and words. A careful analysis of MIL-Q-9858A leads one to conclude that the drafters of this specification were seeking to close as many legal challenges to their idea of a quality program as

possible. The goal of using the existing supplier quality assurance program to fulfill quality requirements of the Government becomes lost in all the Government oversight and inspections, required to conform to this specification. The end result is a requirement on the part of the Government to be constantly inspecting the quality assurance program to ensure compliance with all the various parts of this specification. Thus MIL-Q-9858A becomes an attempt to "inspect quality into the product" rather than build it in, using good quality processes that stress improving the existing production system.

This specification becomes even more encumbering and intrusive when references within MIL-Q are reviewed. A partial list of these specifications, along with brief titles, is given below:

- MIL-I-45208A -- Inspection system requirements
- MIL-C-45662 -- Calibration system requirements
- MIL-STD-105 -- Sampling procedures and tables for inspection by attributes
- MIL-STD-109 -- Quality assurance terms and definitions

This provides much more than broad guidance in how a supplier will establish his quality assurance organization. While the specification clearly says the contractor is responsible for this system, DoD is stipulating rules of operation throughout MIL-Q-9858A that limit a contractor's

options. The scope of this specification is revealed in Note 8.1:

> 8.1 Intended Use. This specification will apply to complex supplies, components, equipments, and systems for which the requirements of MIL-I-45208 are inadequate to provide needed quality assurance. In such cases, total conformance to contract requirements cannot be obtained effectively and economically solely by controlling inspection and testing. Therefore, it is essential to control work operations and manufacturing processes as well as inspections and tests.

This quote clearly shows that the intent of MIL-Q-9858A is to obtain total control over the process and operation of the supplier. There is an implication that if DoD inspects both the end product and the process a sufficient number of times, the quality of the product will eventually meet its expectations.

In contrast to the idea of total control, DoD has promulgated MIL-I-45208A for those contracts that do not need to be as closely monitored because of the nature or complexity of the product.

2. MIL-I-45208A: Inspection System Requirements.

This specification contains fewer requirements than MIL-Q, but it is still based on inspection and detailed accounting of quality by the supplier. There is an attempt to cover as many contingencies as possible and to provide not only guidance, but decisions concerning possible scenarios that might arise during the performance of a contract. These decisions take the form of negative wording regarding any

deviations or foreseeable problems. An example is found in paragraph 2.2:

> **2.2 Amendments and Revisions.** Whenever this specification is amended or revised subsequent to its contractually effective date, the contractor may follow or authorize his subcontractors to follow the amended or revised document provided no increase in price or fee is required. The contractor shall not be required to follow the amended or revised document except as a change in contract. If the contractor elects to follow the amended or revised document, he shall notify the Contracting Officer in writing of this election. When the contractor elects to follow the provisions of an amendment or revision, he must follow them in full.

This paragraph shows how the drafters of MIL-I-45208 tried to incorporate all possible scenarios of a change to a product within the specification. The specification first states that a contractor may elect to follow a revision, provided there is no increase in price. Then it is hypothesized that a contractor might elect to follow only part of the revision and so that becomes forbidden. The hypothesis is taken one step further in assuming a contractor will fail to tell the Government what course of action has been implemented regarding amendments or revisions. To preclude this possible oversight on the part of a contractor, MIL-I-45208 requires that the Contracting Officer be notified in the event an amendment or revision is implemented. A careful reading of this paragraph shows how the original intent of the specification, which meant simply to state that a contractor does not have to follow revisions until they are formally added to a contract, has become an exercise in semantics.

This type of phrasing and writing pervades both MIL-Q-9858A and MIL-I-45208.

D. LITERATURE REVIEW

In order for the researcher to understand the attraction of using international standards, and the movement within DoD to accept them, a survey of current literature regarding international quality standardization was conducted.

1. Change in attitudes during 1980s.

The early 1980s saw the realization that the predominate position of the United States as arms supplier to all its allies -- in particular, its European allies -- was being seriously challenged. The political climate dictated that jobs and technology development in Europe be protected by the European governments. This political drive to give equal status to the European arms industrial base led to serious concerns that soon the North Atlantic Treaty Organization (NATO) would be equipped with incompatible weapons across national boundaries. These concerns gave rise to the concept of Rationalization, Standardization and Interoperability (RSI). The political climate of both Europe and the U.S. was intent on achieving maximum military effectiveness for the money expended. One way of achieving this effectiveness was to create joint efforts that reduced the duplication of research and development funds while increasing the potential market and numbers of weapons eventually deployed. At the

same time, the early 1980s saw the U.S. as the dominant producer of complex weapon systems for the free world. Along with this dominance came a certain amount of parochial interest on the part of American companies and DoD components dealing in the international arena. The U.S. Government and industrial base were viewed by our allies as using defense to protect and justify purely economic decisions. [Ref 6:p.7]

This attitude, that the U.S. would establish contracts with NATO allies to maximize resource use and to ensure NATO compatibility in weapon systems, has been replaced. The new views on international contracting have to do with the realization that the United States is no dominant in many areas and thus must compete for its foreign market share. This new attitude is summarized in the following citation: [Ref 7:p.6]

> This year's NCM Week slogan (Contracting for a Competitive America) is not prophetic; it is descriptive of current real world events. The general downsizing of defense and high technology markets and the increasing competition from essentially equivalent foreign competitors are demonstrable indicators that the economic future offers rewards to those who succeed in international competition and penalties (in the form of decreased market share, fewer jobs, and less profit) to those who do not.

International arms deals are now viewed as a competitive field. Industry and DoD now see foreign competitors as more of an equal and thus the U.S. can no longer dictate the terms of international arms sales.

2. Policy statements regarding quality assurance in international contracts.

The official DoD policy toward adoption of ISO 9000 can be seen in several documents. First, at a broad policy level, there is DoD Instruction 5000.2 Part 6 Section Q (c) Participation in Standards Development Activities, which states:

> DoD Components will participate in standards development activities of non-Government standards bodies, both domestic and **international**, coordinating on such activity with other Federal Agencies.

This policy, in the case of ISO 9000 standards, has been implemented through its inclusion in the Department of Defense Index of Specifications and Standards (DODISS) list of acceptable documents for use in contracts.

The DoD 5000.2 is backed up with an Assistant Secretary of Defense memorandum dated 7 August 1989 that states: [Ref 8:p.1]

> I have been briefed on the series of quality assurance standards recently published by the International Organization for Standardization (ISO). After reviewing the benefits of adopting these ISO quality assurance standards, their wide acceptance around the world, and their implications in international trade, I have decided to follow an approach similar to that taken by NATO. I believe that this approach will provide maximum benefit to the Department of Defense (DoD) as well as American industry.
>
> More specifically, I want to adopt ISO standards, 9001, 9002, 9003 in their entirety and develop supplemental military standards that will incorporate the appropriate ISO standards by reference and provide the requirements for a contractor quality program which may be lacking in the ISO standards.

The Army is the Service branch with cognizance over Quality Assurance for DoD, and thus has the lead in policy generation and modification for quality assurance.

In a brief given by the Assistant Director, Office, Secretary of Defense International Quality Assurance, the following bullets are listed on a viewgraph labeled "U.S. National Position on ISO QA Standards."[Ref 9]

- US has adopted ISO QA Standards: ANSI/ASQA Q-90 Series
- US consensus is ISO Standards are insufficient
- ISO Standards will be revised or reconfirmed in 1992
- Task force to review Q-90 Series Standards established
- Task force authorized under ANSI ASC A-1 committee
- Task force to identify improvements in ISO standards
- These improvements will be provided to US TAG [Technical Advisory Group] and to ISO TC176 [Technical Committee].
- Task force has met several times
- DoD and defense industry are represented

The U.S. Department of Commerce is also heavily involved in the promulgation of information regarding ISO Standards and in assessing the impact they will have when the European Community is formally created in 1992. The abstract shown below is from an article published by the Department of Commerce, National Institute of Standards and Technology, Standards Code and Information Program, Office of Standards Service: [Ref 10:p. ii]

This report provides information on the development, content and application of the ISO 9000 standards to readers who are unfamiliar with these aspects of the standards. It attempts to answer some of the most commonly asked questions on quality; quality systems; the content, application and revision of the ISO 9000 standards; quality system approval/registration; European Community requirements for quality system approval/registration; and sources for additional help.

The literature cited above is meant to give a general sense of what the U.S. Government and in particular the DoD position is with regards to ISO 9000. It is certainly not an exhaustive survey of all the policy issues and actions taken or proposed, but it does represent the largest force within this area of Quality Assurance.

3. Concerns regarding the use of ISO 9000 and the manner in which ISO 9000 Standards are changed.

During the literature review, documents that outline the concerns and perceived deficiencies in ISO 9000 standards were located. These documents are best summarized by a concise overview used during a briefing entitled "ISO 9000 Quality Assurance standards" given during a training session for Quality Assurance Representatives (QARs) in the Defense Contract Management District (DCMD) Northeast. The overview was titled "ISO QA Standards Concerns" and listed the following bullets:[Ref 11:p.12]

- Contractor certification
- Requirements not adequately covered by ISO/ANSI Standards
- DoD guidance document [to be issued in near future]

- Training [QAR training in philosophy and application of ISO Standards]

The issues regarding deficiencies in ISO 9000 Standards are the purview of the International Standards Organization Technical Committee 176 (TC176). TC176 is responsible for overseeing the modifications and additions made to ISO 9000 Standards. The four Strategic Goals of the TC176 were recently defined by using "test" statements. The goals and associated "tests" are shown below.[Ref 12:p.33]

Goal: Universal Acceptance

Tests for the goal of universal acceptance:

- The standards are widely adopted and used, worldwide.
- There are few complaints from users in proportion to the volume of use.
- Few sector-specific supplementary or derivative standards are being used, or developed.

Goal: Current Compatibility

Tests for current compatibility:

- "Part Number" supplements to existing standards do not change or conflict with requirements in the existing parent document.
- The numbering and clause structure of a supplement facilitate combined use of the parent document and the supplement.
- Supplements are not stand-alone documents, but are to be used with their parent document.

Goal: Forward Compatibility

Tests for forward compatibility:

- Revisions affecting requirements in existing standards are few in number and minor or narrow in scope.
- Revisions are accepted for existing as well as new contracts.

Goal: Forward Flexibility

Tests for forward flexibility:

- Supplements are few in number, but can be combined as needed to meet the needs of virtually any industry/economic sector or generic category of products.
- Supplement or addendum architecture allows new features or requirements to be consolidated into the parent document at a substantial revision, if the supplement's provisions are found to be used (almost) universally.

The two documents cited above illustrate the concern many ISO members have regarding modifications or changes to ISO 9000. The standards must be applicable across national boundaries and they must cover all types of industry. ISO developed a method for dealing with modifications of ISO 9000 in order to accommodate the resolution of some of these concerns. In the case of DoD, the stated policy is to issue and impose additional requirements, with regard to the contractor's quality system as needed, to ensure a contractor has an acceptable quality system in place.

E. SUMMARY

The structure and philosophy of ISO 9000 as explained above is designed to facilitate continuous improvement in quality. Thus it is a step closer to a Total Quality Management system as well. On the other hand, the existing Military Standards tend to inspect quality into the product, as opposed to concentration on improvement of the process.

The literature search revealed a concerted policy within DoD to encourage and educate both contractors and DoD personnel in the application of ISO 9000. At the same time, DoD is reserving the right to modify ISO 9000 programs by imposing existing or new quality standards as appropriate for a given contract.

The following chapter compares MIL-Q-9858A to ISO 9001 and MIL-I-45208 to ISO 9002. This comparison highlights differences between the two sets of standards, in order to gain a better understanding of the changes that will result from imposing ISO 9000 in DoD contracts.

III. COMPARISON

A. INTRODUCTION

The structure of the ISO 9000 series of standards makes it easy to compare ISO 9001 to MIL-Q-9858A. But ISO 9002 does not compare well to MIL-I-45208, while ISO 9003 can be thought of as equivalent to inspection by the contractor of his own product or, more broadly, as commercial end-item inspection. This researcher prepared a comparison of ISO 9001 to MIL-Q-9858A and a comparison of ISO 9002 to MIL-I-45208. These comparisons are presented in Appendices B and C of this thesis.

Appendix B compares individual paragraphs of ISO 9001 to corresponding paragraphs of MIL-Q-9858A, while Appendix C compares ISO 9002 to MIL-I-45208 on a paragraph-by-paragraph basis. Thus, a detailed comparison of the standards in regards to a particular subject matter is available by careful scrutiny of Appendices B and C. After completion of these comparisons, the researcher discovered a similar collation completed by the Office of the Assistant Secretary of Defense (Production and Logistics). In reviewing the researcher's comparison as opposed to that of the OSD(P&L), it is evident that the two documents agree only in principle as to possible alignments of paragraphs between ISO 9001 and MIL-Q-9858A.

This wide disparity illustrates the subjective nature of both documents. It is possible to interpret a given paragraph in ISO or MIL-STD in several different ways. The OSD(P&L) comparison is discussed in detail below, and Appendix D of this thesis is a matrix of the OSD(P&L) alignment of paragraphs between ISO 9001 and MIL-Q-9858A.

It should be noted that Appendices B and C adopted the ISO 9000 organization with the right-hand side of the table reflecting the ISO 9000 structure. MIL-Q-9858A (in Appendix B) and MIL-I-45208 (in Appendix C) are then applied to the ISO Standards on a best-of-fit type comparison on the left side of the appendix.

B. GENERAL OBSERVATIONS

After reviewing the detailed comparison of ISO to MIL STD, three general observations were made by this researcher:

1. The ISO standards use the phrase "as appropriate" while the U.S. specifications attempt to list all possible situations to which they might wish to apply a given paragraph.

2. The ISO standards use a clear outline format, which separates the main subjects into short easy-to-read statements, while U.S. specifications employ long narrative paragraphs.

3. The ISO standards take an overall approach and provide broad management structure to the programs they are

seeking to encourage. U.S. specifications appear to direct contractors to take specific action in areas that have caused problems in the past.

A second view of the general differences between ISO 9000 and Military Standards was given during a panel discussion at the 23rd Annual Industry/Government Quality Liaison Meeting held at Danvers, Massachusetts. The following concise comparison of ISO 9000 tc MIL-Q strengths was presented as a panel discussion subject.[Ref 13:p.6]

ISO 9000 and MIL-Q-9858A are generally equivalent

ISO 9000 is stronger in:

1. Design control
2. Management commitment
3. Personnel training/qualification
4. Internal quality audits

MIL-Q-9858 is stronger in:

1. Calibration and measurement
2. Control of nonconforming supplies
3. Government review of QA program
4. Cost of quality

Both are weak in continuous process improvement.

C. RESEARCHER'S COMPARISON OF ISO 9001 TO MIL-Q-9858A

ISO 9001 compares favorably with MIL-Q-9858A. This researcher does not detect any significant differences between

the two. Both documents cover the same areas of process and design control.

ISO 9001 does not currently contain the "layering effect" that is inherent in MIL-Q-9858A. This layering effect is where MIL-Q-9858A refers to other specifications or handbooks that amplify and add more detail to MIL-Q-9858A. There is resistance to additional amplification within the ISO organization and membership. As discussed above, the ISO TC176 has established a set of strategic goals that are designed to avoid the micro-management of MIL-Q implementation practices. One of the goals of ISO is to remain at a basic level that can apply to many different industries and situations.

D. RESEARCHER'S COMPARISON OF ISO 9002 TO MIL-I-45208

ISO 9002 is far more comprehensive and provides more direction than does MIL-I-45208 and is not a close replacement for it. ISO 9002 actually exceeds the MIL-I-45208 requirements in all areas, and is virtually identical to ISO 9001 (with the removal of the paragraphs in ISO 9001 concerning design quality control).

All other provisions regarding process control and documentation remain the same between ISO 9001 and ISO 9002. The use of ISO 9002 in place of MIL-I-45208 has the potential to increase expenditure of resources by contractors to comply

with it, over and above the costs of complying with MIL-I-45208.

E. RESEARCHER'S ASSESSMENT OF SECTIONS IN MIL-Q-9858 AND MIL-I-45208 WITH NO CORRESPONDING ISO SECTIONS

A review of the text for those paragraphs that have no corresponding ISO wording, reveals that these paragraphs do not deal with defining a quality program. Rather, they are directives designed to provide the Government additional legal rights to conduct a detailed or more intrusive oversight of subcontractors. They also ensure legal right to the use of contractor equipment in conducting in-process inspections. These paragraphs are not deemed by this researcher to be applicable to the overall effectiveness of a quality program.

1. MIL-Q-9858A.

The paragraphs of MIL-Q-9858A that do not have corresponding ISO 9001 paragraphs are listed, along with their titles, below:

- 3.6 Cost Related to Quality
- 4.4 Use of Contractor's Inspection Equipment
- 4.5 Advanced Metrology Requirements
- 7.7 Government Inspection at Subcontractor Facilities

The complete text of these paragraphs can be found at the end of Appendix B.

2. MIL-I-45208.

The paragraphs of MIL-I-45208 that do not have corresponding ISO 9002 paragraphs are listed, along with their titles, below:

- 3.8 Qualified Products
- 3.11 Government Inspection at Subcontractor or Vendor Facilities
- 3.11.1 Government Inspection Requirements
- 3.13 Government Evaluation

The complete text of these paragraphs can be found at the end of Appendix C.

F. OSD(P&L) COMPARISON OF ISO 9001 TO MIL-Q-9858A

The OSD(P&L) conducted a comparison, resulting in 38 comments on the differences between ISO 9001 and MIL-Q-9858A. The comments have been broken down by this researcher into broad areas of the standards to which they apply, and are presented below. This OSD(P&L) comparison is meant only as a reference document and not as a policy statement.

1. Scope.

This is paragraph 1.0 in ISO 9001 and paragraph 1 in MIL-Q. The paragraphs are intended in both standards to state the applicability of the standard. OSD(P&L) comments are:

- Mil-Q-9858 states that the contractor is responsible for compliance with all provisions of the contract and for furnishing specified supplies and services which meet all the requirements of the contract. ISO does not have this statement.

- ISO provides for tailoring of specific contractual situations. MIL-Q-9858 does not have such a provision.

- ISO states that it is primarily aimed at preventing nonconformity. MIL-Q-9858 does not state this primary aim.

- ISO applies when the contract specifically requires design effort and the product requirements are stated principally in performance terms or they need to be established. MIL-Q-9858 applies to all supplies or services when referenced in the contract.

- MIL-Q-9858 requires the quality program, including procedures, processes and product, to be subject to review by the Government Representative, to have access to and the right to review and evaluate all aspects of the contractor's quality program. ISO does contain provisions for purchaser review and evaluation except where agreed to contractually. (paragraph 4.16)

The OSD(P&L) comment concerning the prevention of nonconformity as a goal for ISO, while it is not for MIL-Q, addresses the philosophical difference between the two standards. ISO is concentrating on the development of an organization that is set on improvement and the prevention of nonconforming material; MIL-Q concentrates only on inspections and detection of nonconforming material. The last comment regarding access to evaluate the quality assurance system of a company is really a legal issue that has been buried in the MIL-STD, instead of being addressed in contractual language where it appropriately belongs.

2. Quality Systems Requirements/Quality Policy.

This is a paragraph in ISO 9001 to which MIL-Q-9858 has no equivalent. The OSD(P&L) comments are:

- ISO requires the supplier's management to define and document its commitment to quality. MIL-Q-9858 does not require this.

This provision of ISO 9001 clearly delineates the heart of the difference between it and MIL-Q-9858. ISO is designed to create an organization that is committed to continuous improvement of quality, and that commitment has to come from the top echelons of management. MIL-Q-9858 is an attempt to put quality into the process/product through continuous inspection.

3. *Organization/Management.*

The organization and responsibility within the Quality Assurance department of a company is addressed in both standards. OSD(P&L) comments are:

- ISO requires the responsibility, authority, and the interrelation of all personnel who manage, perform, and verify work affecting quality be defined. MIL-Q-9858 requires that the responsibility and authority of personnel performing quality functions be defined. (paragraph 3.1)
- ISO requires the supplier to assign trained personnel for verification activities. MIL-Q-9858 does not specifically require the assignment of trained personnel.
- ISO requires that verification, including inspection, test, and monitoring, be carried out by personnel, independent of those having direct responsibility for the work being performed. MIL-Q-9858 requires that personnel

performing quality functions shall have the organizational freedom to identify and evaluate quality problems. (paragraph 3.1)

- ISO requires that a management representative be responsible for ensuring that the requirements of the quality system are implemented and maintained. MIL-Q-9858 indicates that the fulfillment of the quality program requirements is not the responsibility of any single contractor's organization, function or person.

The ISO standards are written to improve the quality assurance system within a company. An important element of this program is the initiation of a program of continuous improvement. The concept of continuous improvement requires that people be trained and qualified to operate and maintain the quality system described by ISO 9000 standards. The MIL-Q is less stringent concerning employee qualification, because it has an inherent attitude that more inspection will reveal the defects and thus overcome the failures that may exist in the level of training within the company's quality assurance system.

4. Quality System/Program.

These sections of the standards deal with the requirements for establishing a quality assurance system within the company. ISO requires the establishment of a system that covers all phases of the production process, while MIL-Q-9858 is written in terms of a program that is an end in and of itself. OSD(P&L) comments are:

- ISO provides that consideration needs to be given for the preparation of a quality plan (defined in ISO 8402 as a document setting out the specific quality practices, resources and sequences of activities relevant to a particular product, service, contract or project). MIL-Q-9858 does not have any provision for a quality plan.

- ISO provides that consideration needs to be given for the compatibility of the design, the production process, installation, and the applicable documentation. MIL-Q-9858 does not provide for the compatibility of the design and production process.

5. Contract Review/Design, Control/Product, Identification and Traceability.

These are three topics covered by ISO and not covered in MIL-Q-9858. The OSD(P&L) comments are:

- ISO requires the supplier to review each contract and maintain records of these reviews. MIL-Q-9858 requires the contractor to conduct a complete review of the requirements of the contract. Records of these reviews are not specifically required.

- ISO devotes an entire section to design control. MIL-Q-9858 does not address design control.

- ISO requires the identification of the product from applicable drawings, specifications, or other documents during all stages of production, delivery, and installation. Such identification is not required in MIL-Q-9858.

In both these cases, ISO is covering the entire process that a contractor must complete to achieve an acceptable end product. It attempts to avoid an unacceptable end product by ensuring that the entire production process is under control. The MIL-Q relies on an inspection program to

detect and ultimately remove defective products after they have been produced.

6. Document Control/Drawings, Documentation and Changes.

The procedures prescribed in the standards to control changes to the technical data package are fundamentally different. MIL-Q advocates a broader approach in evaluating the adequacy of records keeping with regard to engineering changes, while ISO has specific steps to be followed in this area. The OSD(P&L) comments reflect this difference:

- MIL-Q-9858 requires a procedure for the evaluation of the adequacy of design drawings and specifications in relation to standard engineering and design practices, and with respect to the design and purpose of the product. This requirement is not in ISO.
- ISO requires that a master list or equivalent document control be established. ISO also requires that documents be re-issued after a practical number of changes have been made. These requirements are not in MIL-Q-9858.
- MIL-Q-9858 extends the contractor's responsibility to drawings and changes provided by subcontractors and vendors. This requirement is not in ISO.

The ISO 9001 standard gives more detailed guidance in establishing control over the technical data package. The MIL-Q-9858 leaves this area up to the contractor's established systems. It tries to use an industry best-practices approach to document control, based on the theory that there is such a wide discretionary range in approaching this problem that whatever system the contractor is using is acceptable, as long as it is close to industry practices.

7. Purchasing Control.

OSD(P&L) comments:

- ISO requires the establishment and maintenance of records of acceptable subcontractors. Such records are not required in MIL-Q-9858.
- MIL-Q-9858 provides for inspection by the Government at the subcontractor's plant. ISO provides for the purchaser or his representative to verify at source, when specified in the contract, that the purchased product conforms to specified requirements. (para 4.6.4)
- MIL-Q-9858 requires the use of test reports, inspection records, certificates and other suitable evidence relating to the subcontractor's control of quality. MIL-Q-9858 requires the contractor to have procedures for the early information feedback and correction of subcontractor nonconformances. This is not required in ISO.
- MIL-Q-9858 includes requirements for chemical and physical testing and recording in connection with the purchase of raw materials by suppliers. Such testing is not required in ISO.

The ISO standards reflect an attitude that contractors should use a "best value" approach in selecting their subcontractors. The definition of "best value" is the attainment of maximum benefit from money spent in terms of satisfying requirements of the contract. Thus, the establishment of long-term relationships between contractor and supplier is not looked upon in Europe as being "collusive" as it frequently is in the U.S. DoD stresses use of the lowest bidder for subcontract work, creating a barrier to development of long-term relationships. If a subcontractor is not the lowest bidder for future business, the prime contractor is obliged to select the lowest cost proposal,

regardless of past performance considerations. The value of a proven subcontractor carries little weight when prime contractors are evaluated for control of subcontracts by DoD. The MIL-Q-9858A is relying on incoming inspection to detect defective products, rather than trying to establish a rapport with a subcontractor to eliminate substandard material.

8. Purchaser Supplied Product/Government Property.

ISO 9001 has a brief three-sentence paragraph that requires a procedure be set for receipt, storage and reporting of problems

regarding purchaser supplied material. There are no specific directions as to protection and disposition of such material. Meanwhile, MIL-Q-9858A has three lengthy paragraphs that explain what action will be taken if problems arise with Government Furnished Property (GFP). MIL-Q-9858A attempts to cover all contingencies of this situation. The OSD(P&L) comment is:

- MIL-Q-9858 requires the contractor to provide more specific protection of Government-furnished material. The control of purchaser supplied product in ISO is more general.

9. Process Control/Work Instructions.

These sections of the standards discuss how a company documents the division of labor within the manufacturing process. In essence it is how the bill of material and labor sheets are written. OSD(P&L) comments:

- ISO requires work instructions defining the manner of production and installation only. MIL-Q-9858 requires work instructions for purchasing, handling, machining, assembling, fabricating, processing, inspecting, testing, modification, installation, and many other treatments of product, facilities, standards, or equipment.

The OSD(P&L) comment on this section of the standards would lead one to conclude that it covers less than MIL-Q-9858. In reality, ISO 9001 encompasses more than MIL-Q-9858 in this area because it focuses on covering the entire manufacturing process with controlled written procedures. The MIL-Q-9858 states the requirements for this area in terms of "all work affecting quality." Since ISO covers the entire process, i.e., all work affecting quality, both standards are identical in intent.

10. Inspection and Testing/Manufacturing Control.

ISO 9001 concentrates on establishing a process that assures an acceptable incoming product from suppliers. MIL-Q-9858 relies on inspection to single out nonconforming material. OSD(P&L) comments:

- MIL-Q-9858 requires raw materials to conform to the applicable physical, chemical, and other technical requirements. Laboratory testing shall be employed as necessary. ISO does not require such testing.

11. Final Inspection and Test.

The OSD(P&L) comment in this area is:

- MIL-Q-9858 requires reporting to designers any unusual difficulties, deficiencies or questionable conditions

during final inspection and testing. ISO does not require this feedback.

The OSD comment in this area fails to view ISO 9001 in its entirety. ISO requires more formalization of feedback/corrective action procedures than does MIL-Q-9858. It simply does not list those corrective action steps at this point in the standard. The philosophy that supports ISO 9001 would say that nonconformance at final inspection means there was a failure of the quality assurance system because it failed to prevent the nonconformance in the first place.

12. Measuring and Test Equipment.

The OSD(P&L) comments:

- MIL-Q-9858 is more specific and elaborate in the area of measuring and test equipment by requiring conformity with MIL-C-45662.
- MIL-Q-9858 requires the contractor to make his gauges, measuring and testing devices available to the Government. ISO does not have this requirement.

The first comment listed above seems to be a moot point. If a company is using ISO 9001, it can supplement it with other standards. For example, a contract written using ISO 9001 as a requirement, still can designate MIL-C-45662 (calibration) as a required technical specification.

The second comment listed above concerning Government access is another example of where MIL-Q-9858 was used as a vehicle for contractual requirements that belong elsewhere in a contract, not in the quality assurance standard.

13. Control of Nonconforming Material.

In the area of the nonconforming material, ISO 9001 and MIL-Q-9858A take different approaches to resolving rework, due to the difference in the philosophy of the standards. ISO views rework as a source of information back to the process that improvement is possible. Thus ISO specifies that rework effort is to undergo the same inspection as the original effort. MIL-Q-9858A calls for separate procedures to resolve rework, thus removing a feedback loop back to the original production process. The OSD(P&L) comments are:

- MIL-Q-9858 states that the acceptance of nonconforming supplies is a prerogative of, and shall be as prescribed by, the Government. ISO does not have an equivalent statement. MIL-Q-9858 requires that repair or rework be in accordance with documented procedures acceptable to the Government. Procedures for repair or rework are not required by ISO. ISO requires that repaired and reworked product be re-inspected in accordance with documented procedures. MIL-Q-9858 does not require re-inspection.
- MIL-Q-9858 requires data associated with the costs and losses, in connection with scrap and rework, be made known to the Government. This is not required in ISO.

14. Handling, Storage, Packaging and Delivery.

The intent of both standards is the same in this area; the comment below seems to this researcher to be one of semantics:

- MIL-Q-9858 requires periodic inspection for the prevention of deterioration or damage in storage. ISO requires periodic assessment of product in stock to detect (not prevent) deterioration.

15. Quality Records.

Because of the emphasis in MIL-Q-9858 on final product inspection, the MIL-STD sets specific requirements for records- keeping regarding final inspection. ISO relies on feedback and continual improvement, leaving open the exact form of the data, so long as it is brought to the attention of personnel responsible for the area being tested. The OSD(P&L) comments are:

- MIL-Q-9858 requires records to indicate the nature of the observations, together with the number of observations made and the number and type of deficiencies found. ISO does not specify the contents of the records.
- MIL-Q-9858 requires records to be used as a basis for management action. ISO does not have this requirement.
- MIL-Q-9858 does not have a requirement for internal quality audits as required in ISO.

16. Training and Servicing.

These are two areas not covered by MIL-Q-9858. OSD(P&L) comments:

- ISO requires a procedure for the identification and provision of training for all personnel performing activities affecting quality. MIL-Q-9858 does not have this requirement.

- ISO requires procedures to assure that servicing requirements are met. MIL-Q-9858 does not cover servicing.

17. Statistical Techniques.

The ISO Standards require statistical methods of control be applied to all processes covered by the standards. MIL-Q, on the other hand, uses sampling to conduct inspections. Again it is the fundamental attitude of either controlling the process [ISO] or inspecting the end product and removing unacceptable material [MIL-Q]. OSD(P&L) comments are:

- ISO requires the use of statistical techniques for process capability and for product characteristics. MIL-Q-9858 does not have provision for such statistical techniques. MIL-Q-9858 allows the contractor to use sampling procedures for product acceptance. ISO does not specifically allow sampling.

18. Costs Related to Quality.

This is the one major area found in MIL-Q-9858 which is totally absent in ISO. OSD(P&L) comments:

- MIL-Q-9858 requires the contractor to maintain and use quality cost data. ISO does not require quality cost data.

G. SUMMARY

An armchair comparison of ISO 9000 to Military Standards leaves this researcher with the impression that a change to ISO would not be difficult, and the resulting Quality Assurance program changes would aid in improving quality and reducing costs. A survey of contractors, described in the next chapter, reinforces this impression.

IV. DATA ANALYSIS/INTERPRETATION

A. INTRODUCTION

The data presented in this study were gathered through a sampling of 24 managers or directors of quality assurance departments from companies that are ISO 9000 registered and were selected on the likelihood that they were familiar with MIL-STDS. Each survey was conducted by telephone and lasted from 20 to 45 minutes. The respondents were encouraged to answer freely on a nonattribution basis. The aggregate listing of respondents is presented in Appendix A.

In order to reach companies primarily concerned with DoD contracting, only those companies listed in the following categories were contacted: [Ref 14]

- Rubber and Miscellaneous Plastics Products
- Primary Metal Industries
- Fabricated Metal Products
- Industrial and Commercial Machinery and Computer Equipment
- Electronic and Other Electrical Equipment
- Measuring, Analyzing and Controlling Instruments
- Wholesale Trade - Durable Goods

The researcher was interested only in contacting those companies actively involved in DoD contracts and that were

aware of ISO 9000 Standards. As a result, the data are heavily biased toward positive comments regarding ISO 9000 because the firms contacted have already demonstrated a strong commitment to ISO 9000 by completing the registration process.

Of the 25 companies interviewed, 20 of them are registered to the ISO 9001 standard and five are registered to the ISO 9002 standard. All of the respondents were managers or directors of quality assurance departments within their companies and all had recent experience with the registration process. In many cases the person interviewed was responsible for planning and achieving ISO registration, and was thus very familiar with the problems faced by a company attempting to achieve registration.

B. THE RESPONSES

1. Question One.

Does your company currently, or has it in the past, performed DoD contracts that specified compliance with MIL-Q-9858A or MIL-I-45208?

a. Discussion

The purpose of this question was to determine if the person interviewed was familiar with MIL-Q-9858 or MIL-I-45208 and if the company fell into the target group of DoD contractors.

b. Analysis

In 24 of the 25 companies interviewed, the person contacted was familiar with MIL-Q-9858. This familiarity included compliance with MIL-STDS on current or previous contracts and a thorough knowledge of the quality assurance system their company designed in order to comply with MIL-Q-9858 or MIL-I-45208. Of this group, only 16 were actively involved in DoD contracts at the time the interview was conducted.

2. Question Two.

Was your company aware of DoD's policy to use ISO 9000 in contracts, and if so, was it a factor in your company's decision to attain ISO registration?

a. Discussion

This question was asked in order to get a feel for the level of awareness in industry with regard to ISO implementation by DoD. There were eight people interviewed who knew that DoD was reviewing the use of ISO 9000 in DoD contracts, and only three who knew that DoD was contemplating the replacement of MIL-Q-9858 with ISO 9001. The official position, as expressed by the Assistant Secretary of Defense in 1989, was completely new to all 25 respondents. When asked if DoD policy on ISO 9000 was a factor in getting registered, only one person said it was, and he quickly stated that it was only a minor factor.

b. Analysis

The survey made it clear that the driving force for a firm to become registered is centered on remaining competitive in the global marketplace, in order to sell to the European Community after 1992. None of the comments indicated that consideration of future DoD business was a factor in the decisions. The decision to become ISO 9000 registered is obviously based on a desire for additional international sales. Some of the comments regarding this international marketplace are paraphrased below:

- We went after 9001, [because] we are a U.S. company that does a lot of work in Europe and [we] export a lot to Europe. There is a theoretical requirement that by December of '92, ISO 9000 will be required to do business within the European community. So ISO 9000 is driven by the commercial customers in Europe.

- [ISO 9000] is an advantage in the international [markets]. But it [ISO 9000] will become it [quality assurance] in the U.S. in very short order, I can see it. Our competition is scrambling right now because we have it and they don't. And we are going to just start flaunting it from a marketing point of view.

- I think the primary impetus of this activity is that we have a high percentage of international (especially European) sales. And it is part of the Europe '92 initiative. We felt this was important.

- A number of years ago we started to pick up on this kind of requirement in the international community. We deal with a lot of major contractors -- international contractors -- and we started to see a lot more stringent quality requirements come through with regard to contracts. So we looked to see what was out there, and found that this standard had been revised in '87 and that a number of countries (40-some-odd of them) had also pretty much duplicated their national specs, such as our

ANSI ASQ C90, so at any rate, that is why we started considering it and that's why we did it.

- ... by virtue of us trying to maintain the ability to sell in Europe. So the influence from the European Economic Community had influence as well.

- ... ISO standard has been applicable since '87 and [the motive] was more that; if you intended doing business in the European Economic Community, you should address that criterion.

- We became ISO 9000 qualified for a specific commercial sale. A customer of ours was looking for a marine industrial engine. It was a European customer and required that we be ISO 9000 certified.

In addition to the marketing drive to remain competitive, the researcher also discovered that, for some companies, ISO 9000 is simply their next step down a road to continuous improvement and ultimately Total Quality Management. This situation is illustrated by the following paraphrased comments:

- ... we were in the throes of, and still are in the throes of, finalizing implementation of a total quality management system. Well, we have about 10 different subsections in our quality management program. And there are 63 different clauses that we try to follow and about 80 percent are required by ISO. So getting the ISO registration brought us to better than 80 percent into implementing our total quality management system. It gave us a nice independent third-party evaluation of where we were in implementing our own quality program. So that fortified our whole quality organization, made us feel pretty good. We were further than we realized.

- We originally started with what they call QMI -- it's a division of Canadian Standards Association. It's like the ASME with Canada. Now they're going to all QMI or now ISO 9000, but some three years ago we went with the QMI and passed this Canadian audit, and it was just a very minute revising of our manual to get into the ISO 9000.

It should be remembered that this group of companies is in a select minority. There are only 225 U.S. firms registered to the ISO 9000 Standards and they are the very early leaders in a growing movement toward international standardization of quality. The firms contacted were selected on the likelihood that they were involved in high technology fields of production. The ISO 9000 Standards are more easily implemented in the manufacturing environment, and return the most benefit to firms engaged in high technology fields requiring a high degree of quality control in their production processes.

3. Question Three.

If DoD puts ISO 9000 requirements in a contract, would your company also agree to use your ISO registrar as an arbitrator of disputes between your firm and DoD?

a. Discussion

This question was designed to support or refute a recommendation that will be discussed in the next chapter of this thesis. It was explained during the interview that the ISO registrar would be contacted only as a last resort in the event of a deadlocked position arising between the Government and contractor. In addition, the loser would pay the expense of having retained the arbitrator. This payment provision was added to ease concerns that the Government would stonewall a contractor and drag all quality disputes before a registrar,

leaving the bill for registrar services to the contractor for payment. This entire suggestion of incorporating the ISO registrar as a last-resort arbitrator was intended to provide a new method of handling quality disputes with contractors, in such a manner as to reduce cost and delay factors associated with some of the really difficult disputes between DoD and contractors over quality issues.

b. Analysis

All 25 respondents to this survey were enthusiastic supporters of implementing ISO 9000 Standards in DoD contracting, and for using registration as certification that a contractor's quality system was satisfactory for DoD contract purposes. Thus pre-award survey audits, to determine if a contractor has an acceptable quality system in place, are no longer performed. If a contractor has current ISO 9000 registration, his quality system is automatically acceptable on a pre-award survey.

The issue of arbitration was suggested by the researcher as a means to achieve even more benefit from a contractor being ISO 9000 registered. Arbitration becomes applicable in those situations where a Government Quality Assurance Representative (QAR) believes the contractor is not adhering to the quality policies and system used during the registration process. A complaint filed by a QAR with a company's registrar would jeopardize the company's ISO 9000

registration, and any commercial business requiring that registration. The final tally on the arbitration issue showed 14 in favor of it, eight opposed, and two interviewees who refused to commit either way. The main reason for opposing the arbitration appeared to be that it was unnecessary because disputes should be settled before they reach arbitration. A sample of comments along these lines is paraphrased below:

- I don't think it should be necessary to bring a third party into the picture. It should be something that we as the company and the Government should be able to resolve between us.
- Any company, I think, would not want to have an outside party control their destiny. If there is a disagreement, they want to have the ability to negotiate it without having someone else come in and say you're right or wrong.
- I really rather see it worked out between the supplier and the customer and come to a consensus, rather than bring in a third party.
- ... if you accept the thesis that anybody that comes in should be thoroughly knowledgeable and professional in the auditing art or science, or both, then disputes that must be taken to arbitration should be almost nonexistent. I am a certified quality auditor, and I feel I should be able to resolve issues like that with a qualified auditor who comes in my building. I know his business as well as he does and we ought to be able to resolve those issues; if not, then I feel comfortable that I wouldn't take something to arbitration unless I really felt I was on secure ground.
- ... basically, nobody likes to air his dirty laundry where it might get back to the customer. It could get to the competition somehow, somebody, might just pass it along. I always worry about that sort of thing getting into the so-called wrong hands, whatever that means.
- We don't want disputes to reach that level. You are really asking for an independent mediator.

- I would think that before [arbitration] I would prefer to escalate it internally. Have more senior quality officers be involved, rather than going to external arbitration.
- Well, by and large, I think the military side and the commercial side, the third party side, of auditing are pretty much in agreement on these things. After 20 years, I haven't seen things that couldn't be thought through and worked out at the plant level.
- I think the first move should not be going to UL. The first move should be coming to the contractor, giving the contractor an opportunity to correct the oversight. If there is dispute on interpretation of what the program is requiring, that should be resolved before anything else occurs.

The predominate response to the question of using arbitration was that it should be unnecessary. Yet, when asked, many of the people interviewed agreed that arbitration as a last resort was a good idea. The Contracting Officer who puts ISO 9000 into a contract may want to consider the use of ISO 9000 registrars as arbitrators. The idea of arbitration is particularly appealing when dealing with contractors or industries that have a history of sending quality problems up to higher levels of management for resolution. The data indicate that use of registrars as arbitrators would not create a prohibitive barrier for ISO 9000 registered contractors bidding on a contract.

In addition, the ISO 9000 philosophy, which says that customers should receive the quality of product they desire, provides additional motivation to avoid disputes between customer and contractor. The probability of disputes

is reduced by adopting fully the ISO Standards, regardless of any arbitration clause that might be a part of the contract.

The follow-up discussion concerning the use of registrars as arbitrators revealed insights into two more systemic problems regarding quality assurance that ISO 9000 has the potential to resolve or alleviate. These potential problems include:

(1) Adversarial attitudes. There were repeated comments that implementation of arbitrators would increase the adversarial posturing that now exists. Samples of these comments are paraphrased:

- It would be a concern, just because it throws somebody else into the equation and gets an adversarial relationship going instead of the teamwork atmosphere and the partnership atmosphere that ought to be going between the customer and supplier. There's been too much of that in the defense portion; I saw it over at ... too much and there's too much of it in non-defense anyway. But it is getting better.

- I think the registrar could be used between the two participants where they contact the registrar and get the registrar's point of view on it. But as an official legal arbitration device, I'd just hate to see that happen because it gets the adversarial relationship going again. It's us versus you. Let's call this third party to decide between us, and they decide, and now I'm angry because they decided against me, and I resent that ...

The discussion of registrars as arbitrators revealed just how hostile the relationship between DoD and defense contractors can become. The interviewees are all

experienced quality assurance managers whose comments show a sensitivity toward any idea or proposal that has the potential of increasing the adversarial attitudes between DoD and defense contractors.

(2) Quality of Government versus ISO auditors. A second topic that arose frequently during discussions of registrars as arbitrators dealt with comparisons of ISO auditors to Government auditors. These comparisons surfaced when interviewees were discussing the advantages of using ISO registrars to settle quality disputes. A sampling of these comments is provided below:

- I gave a paper at a symposium awhile ago talking about 9858 and that was one of the biggest [topics]; ... it was to a mixed group of military and civilian-type people ... the thing that I harangued on was the qualification of the auditors that came into my plant. I got all sorts of grief, because I said that these people aren't professional ... they're misfits, malcontents, and otherwise unqualified individuals who couldn't forge a career for themselves in other places and they got dumped into the quality area. I really resent that. I resent those kinds of people coming into my plant and casting my destiny. They focus on the minutia and the wherefores and the whereases and they do not understand the major issues involved to assure the integrity of the product being delivered to them.

- Right now I am more impressed with the auditor from the registrar than I have been from the Government folks.

- What we find is that ISO auditors dig much deeper in certain areas because they are looking at the whole business cycle as opposed to what Government auditors do.

- The other benefit that you can include in your thesis is that the third parties are also audited, whereas, no one audits DCAS. And also the third-party auditors are all certified through the European [accreditation process].

> All of the auditors that these folks use are certified by them. So you are coming in with some extremly heavy weights instead of someone that's very well versed in one topic. The benefit of that is that these folks will come in and they do an in-depth three-to-five-day survey, [every six months] much like you do with the QARs initially or every three to five years.

The main complaint concerning Government auditors appears to be a lack of training and an adversarial attitude. It should be pointed out that the ISO auditors are paid by the company they are auditing and thus probably treat the people they are auditing as their customers. This does not imply that the ISO auditors aren't rigorous in their audits. They do have their reputation and professional standards to maintain, but an auditor does not have to assume an adversarial attitude to be effective.

The second area of difference noted is directly tied to the level of training and education. The ISO-registering companies are sending experienced and highly trained professionals to conduct these audits. These professionals usually have technical or engineering backgrounds and frequently have extensive experience in the industry they are auditing. This level of professionalism makes communication with the audited company much easier; the company being audited is not "training" the auditor.

The entire question of how to implement ISO 9000 brings with it opportunities to improve the way DoD

administers quality assurance oversight. At the same time, any changes implemented in this field bring with it the risk of aggravating the adversarial element found in some areas of DoD contracting .

4. Question Four.

If DoD were to impose ISO 9000 Standards, including registration, what are the barriers that a company faces in complying with ISO 9000?

a. Discussion

The cost of registration is the obvious starting point when discussing the impact of imposing ISO 9000 standards, but the researcher was also interested in determining if there were other barriers created when ISO 9000 is contractually imposed. The cost to become ISO 9000 registered varies dramatically, based on several factors including:

- what registration authority is selected to perform the audits and registration;
- the condition of the quality assurance program before the initial registration audits are performed; and
- the size and type of business that is applying for registration.

b. Analysis

The registrars work on a cost-per-hour basis. If a company is prepared before the registrar makes the initial audit and review of the company's quality program, than the

time spent by the registrar is greatly reduced and cost of registration is lowered. There are numerous consulting firms that provide pre-registration preparation services to help reduce the time and expense associated with the registration process. Thus, it becomes difficult to determine the cost of registration for any given company or industry. A firm that has a solid quality assurance program in place will greatly reduce its registration expense in contrast to another company of comparable size and industry that is using only a limited program of end-item inspection. The interviewees frequently mentioned that a firm operating under MIL-Q-9858 is well on the way to ISO 9000 compliance and thus faces a lower registration cost.

The researcher followed up the comments on cost (given registration costs were a problem) with the question: are there any other barriers that ISO imposes that would keep a company from completing registration? The answers in this area fell into the following four different categories.

(1) The Scope of ISO is Too Broad. In the first category are those comments that describe ISO 9000 as a broad document that requires a great deal of effort on the part of management to interpret and customize in order to implement it. A sample of these is paraphrased below:

- This ISO document is a short document that has very little in terms of how to do anything. What it does tell you is what you must do. Design is a good example; it says you

must state the design requirements, you must implement the design, demonstrating that you are complying with the requirements, you must verify [and] have the documentation to show you have satisfied the design requirements and you must verify independently. That's all it says; it doesn't tell you how to do it.

- ... not that it is complicated, but I see companies struggling with it only because the standard itself is not articulate so that you can go and address specific areas; there is some interpretation involved.

- The hardest part with ISO is to make sure that you interpret it in the manner that it needs to be interpreted.

- The ISO 9000 in my mind is basically a blank sheet of paper. It is a tell-us-what-it-is-you-do. It gives minimal guidance in the implementation of our quality process.

These comments seem to imply that implementation of ISO 9000 Standards requires the company management's *commitment to review and modify* its quality system, based on broad guidelines that require upper management interpretation. This indicates that ISO 9000 is not a cookbook approach to implementing a new quality system in a company. It requires the effort and time of the entire organization to successfully accomplish ISO registration.

(2) Differences in Philosophy. The second common category of comments flows out of the interpretation issue raised above. Several of the people interviewed clearly drew a distinction between the philosophy underlying ISO 9000 versus the normal U.S. approach to the design of a quality system. The interviewees all point to ISO being a step toward

continuous improvement and Total Quality Management. To the extent that ISO represents a fundamental change in the way companies view their quality assurance efforts, it can prove to be a barrier to a company's willingness to adopt ISO Standards. Add to this the fact that a lot of companies are quite satisfied with their current quality assurance systems and the imposition of ISO Standards could well eliminate potential suppliers from obtaining DoD contract awards. A few of the representative comments in this area are paraphrased below:

- ... a lot of companies have vertical quality control and quality assurance. What I mean by that is the technical product control, if you will, within the actual manufacturing process and maybe even the design and development process, but the ISO 9000 is addressing the whole company. And this is what's new to U.S. businesses. It goes with the whole issue of continuous improvement and Total Quality Management.

- Yes [there are barriers other than just cost] and it's primarily that some companies have quality systems in place that do not parallel ISO 9000. They feel their quality systems are very adequate and are very happy with them, and they are producing quality products. This might be especially true in the case of a larger company -- let's say Motorola or something like that where if you have to go in and make changes to the system it's [impact will be felt throughout the organization]. Whereas in a smaller company where you can quickly make a little change, it does not impact you. If you have to make a massive change across the board [in a large company], you have to communicate it to all people, put new procedures in place, etc. So there is that concern among those companies.

(3) Organizational Resistance to Change. The third category of comments is simply the age-old problem of an organization's resistance to change. ISO represents change to many of the firms implementing it. A few of the representative comments along these lines are paraphrased:

- It is people's resistance to change, that is the biggest one. There are no drawbacks to it, other than the fact that it does cost you a couple of bucks. But people that have been doing business as usual for so long are so resistant to change; that is probably by far the biggest hurdle to overcome.
- The only other factor, of course, is that it is new and they are not familiar with it, and they would have to learn it and learn about it.

(4) ISO is Difficult to Use in Some Environments. This fourth category came from people who were responsible for implementing ISO in their companies. The comments dealt with the problem of implementing ISO in an environment that is not purely manufacturing. Many companies in the high technology fields incorporate some creative design efforts within their manufacturing systems -- in particular, the computer software efforts that are needed to support many of today's high tech products. These people found implementing ISO, where there is no clearly defined process, to be a challenge. Some of the representative comments follow:

- There are organizations that are very well structured, typically a manufacturing organization and somewhat a service organization, or even a hardware engineering organization, which are more accustomed to rigor and process. If you try to implement this in a software world where there is more freedom of product expression, most places don't have that level of rigor in their software environment. So implementing this process in a software world will require a fine balance of a process which is flexible enough to allow that creativity but sufficiently defined to allow a defined and controlled process flow. And that is a fine level which is, I think, not obvious to implement.

- It was much easier and quicker [within our company] for our manufacturing/logistics organizations and our hardware engineering organization to come up to speed. The software side [still] has a long haul.

- What you need to be able to do is define a process which gives an overview or the right templates of things to address, but doesn't make everything required for every implementation because of the different size of the projects [or] scope [or] technology. Basically you have to give a framework or a guideline and then leave it up to the individual implementation of what makes sense for that particular project.

This last set of comments raises the issue that imposing ISO in a Research and Development (R&D) type contract would prove to be extremely difficult. This same issue arises when judging the quality of R&D or software under MIL-STDS. The current solution to this problem is to impose MIL-I-45208 or some other end-item delivery inspection. ISO 9001 and 9002 are not equivalent to MIL-I-45208 because they do not stress end-item inspection. The underlying theme of ISO is to judge whether the quality system is within design parameters and if there is room for improvement. It is hard to make these

judgments when the process is not well defined or amenable to quantifiable measurement.

5. Question Five

If you were given the opportunity to tell DoD what it should do with regards to ISO 9000, what would you say?

a. Discussion

This question was meant to elicit general comments and provide an opportunity to benefit from the collective experience and wisdom of this unique group of people.

b. Analysis

The question yielded a wide scope of answers and what is paraphrased below are those comments the researcher felt were most pertinent to a DoD Contracting Officer.

- I believe that unless a company is third-party accredited and there is some formal process of audit and review of the quality system, then there is no way for anybody to tell whether that company or group is really performing and adhering to that standard. You are required to do internal audits, but there is no way anybody can demonstrate that they are adhering to their own quality manual or quality policy statements or whatever, unless there is some form of quality auditing being performed.

- I believe that from the standpoint of us competing, and the things that are being learned these days on how to manage and control products and processes, I think you have to rethink how we've historically done it and start utilizing some of these new concepts. If we don't, then we don't compete very well and we don't do things very timely. Our company has shown some dramatic changes. Even though we struggle in different areas, it is an ongoing kind of thing and just by focusing on process management and things of this nature, I think you see dramatic changes in the way companies operate.

- One thing that is obvious, and you are probably well aware of it, is that 9001 is not nearly enough. There are gaping holes in those standards that need to be addressed to have a truly competitive company. For example, nowhere in ISO 9001, 9002 or 9003 do you see a requirement for a total quality environment in a company--one that's driven towards quality improvement and things like that. You touch on it in the corrective actions sections, but there is nothing in there, [like] clause 3.6 of 9858 telling you to measure quality costs. It caused a lot of consternation in industry, but it's a hell of a good idea.

- It is not only a benefit to doing a better job of managing our business, but it's also a vehicle for staying in the game with our customers. And there is nothing we did to achieve compliance that didn't make good business sense.

- My experience in complying with 9858 goes back 10 years. There seemed to be more concentration on the form of what the document requires, as opposed to the substance of what the requirement of the document was. The auditors that came in spent all their time looking at whether a gauge was out of calibration. And when they found one, -- Hurrah! That was a big victory for the auditors under 9858. That philosophy and mentality doesn't seem to persist with ISO.

- We are just afraid that ISO 9000 in the next five years is going to lower its standards. We don't want [ISO] to lower their standards. But it is so backed-up like you wouldn't believe, with ISO requests. I just hope they don't lower their standards because of the workload.

- It is one of those hard things to quantify, but I can judge quality, and I can figure out the cost of quality here. We recently acquired another company and my credits, as far as customer returns, have not changed. Yet I have doubled my line items from this building alone. This is absorbing inventory from three major warehouses and our quality has not suffered. Not to mention, we recently hired 30 new people and the training that we had put in place, has been working out fantastically. I have 30 [new] people here who I never felt that training curve as far as our credits [customer returns] to line items go. As much as getting the ISO 9000 certification did for us, from a sales standpoint, it did as well for us from a quality standpoint.

- [With] ISO I have a concern that it might get locked in concrete. That could be a problem, along with

interpretation of it -- the same interpretation problems you get in MIL-Q-9858, even with the handbook H50 available [are inherent in ISO].

- It is a very positive step [to go to ISO 9000]. However, there is a risk that if you focus too much on process, then you lose some of your product metrics which is the traditional QA approach. My fear there is that process focus is good long-term business effort, but if it is focused just on process without tying to some direct product results, you can easily miss the mark and waste your energy.

These general comments are intended to highlight potential future problems for Contracting Officers. Each observation sheds valuable light on such situations. And since these observations come from experienced ISO 9000 quality assurance managers, they are worth noting.

C. SUMMARY

The telephone surveys revealed an enthusiastic and growing support for ISO 9000 among professional quality assurance managers. The current number of U.S. ISO-registered companies is 225. As this initial base of companies increases, the application of ISO 9000 Standards in DoD contracts will undoubtedly grow and will replace MIL-Q-9858 and MIL-I-45208. It is incumbent on a Contracting Officer to stay abreast of this development and realize the potential and actual impact of making this change in quality standards.

Chapter V summarizes the data discussed and analyzed in this chapter, draws conclusions, supports recommendations for

implementation of ISO in DoD contracts, and suggests areas for additional research.

V. CONCLUSIONS, RECOMMENDATIONS AND AREAS FOR ADDITIONAL RESEARCH

A. INTRODUCTION

This study has attempted to assess the movement toward adoption of ISO 9000 Standards in terms of DoD contracting. In order to make that assessment, Chapter II discussed the new international ISO 9000 Standards and their equivalent MIL-STDS. This discussion was followed by a detailed comparison of the two sets of standards in Chapter III. Once this basic understanding of what ISO is, versus MIL-STDS, the researcher interviewed current users of ISO 9000 in order to solicit their input regarding the use of ISO Standards in Government contracting.

Based on both the survey performed and the comparison of ISO to MIL-STDS, the researcher has developed the following conclusions, recommendations, answers to research questions and areas for additional research.

B. CONCLUSIONS

One of the purposes of this study was to provide an assessment of the current movement within DoD and industry as to the adoption of ISO 9000 Standards. Regarding that assessment, the first conclusion of this study is:

1. The DoD policy toward ISO 9000 is not currently a factor in the decision of companies to become ISO 9000 registered.

The responses to the second question of the telephone survey clearly indicate that DoD quality assurance policy was not a factor in the decision to become ISO 9000 registered for those companies that have completed ISO registration. It should be noted that the companies contacted represent the leaders in the movement to ISO 9000 Standards. The motivation of these leaders is based on their marketing strategies for international sales. Each of these companies intends to comply with ISO 9000 in order to remove a barrier to their participation in international markets, and in particular, the European markets.

In the event that DoD makes ISO 9000 compliance a contractual requirement, this conclusion would undoubtedly change radically. It should be remembered that this study was conducted during a time when ISO 9000 is still in its infancy in the U.S. There were only 225 companies that were ISO 9000 registered at the time the telephone survey was conducted.

The conclusion that current and/or contemplated DoD policy is not a factor in the decision to be ISO registered, does not preclude such policies from becoming key factors in ISO registration, once it becomes widely known that DoD is considering using ISO standards in place of applicable MIL-STDS.

The second conclusion of this study is:

2. The adoption of ISO 9001 in place of MIL-Q-9858A will have no major cost impact for those companies currently operating under MIL-Q-9858A.

This conclusion is drawn from the comparison of ISO 9001 to MIL-Q-9858A, presented in chapter III, and from numerous comments made by people during the telephone survey. Several contractors remarked incidentally that they saw no difference between ISO 9001 and MIL-Q-9858A. A number also stated that the system they had developed for compliance with MIL-Q-9858A covered the majority of the compliance requirements contained in ISO 9001. The OSD(P&L) comparison cited in Chapter III also concluded that ISO 9001 and MIL-Q-9858A are fundamentally compatible as to scope and cost impact.

The significance of this conclusion to Contracting Officers will become apparent in future meetings where contractors will cite ISO 9001 requirements in a contract as the basis of increased cost to fulfill the contract. Any assertion of added cost due to the use of ISO 9001, from a contractor who is currently conforming to MIL-Q-9858A, should be seriously challenged. To the extent changes to quality assurance procedures are required to conform to ISO 9001, such changes should be relatively minor in scope and cost impact. The philosophy of ISO 9001 is to ensure that the process remains under control, and emphasizes feedback that leads to

continuous improvement of the process. In addition, any costs incurred in changing quality assurance procedures should be part of an indirect overhead expense pool. These costs should be borne across all segments of a firm's business.

If a contractor were to cite the direct costs of becoming ISO 9000 registered as a basis for added contract costs, the Contracting Officer has two responses. First, registration is not currently a DoD requirement. Second, if DoD were to make it a requirement, the company would realize some benefits in the registration process that offset any direct costs incurred. These benefits were mentioned by several of the persons interviewed during discussions concerning survey question four. The cost of registration was always cited as a barrier to adopting ISO 9000, but several contractors were quick to point out that the registration process helped identify weaknesses in their current quality assurance systems. These weaknesses had to be corrected prior to achieving registration; thus the registration process acted as a catalyst for improvements that yield future benefits. This correction process was considered by several quality assurance managers to be a significant source of improvement that will bear tangible savings in the near future. An independent third party, coming in to review a company's entire quality assurance system, is bound to generate new ideas and points of view that incumbents of a system have failed to recognize. The quotes cited in Chapter IV

concerning the perceived quality of ISO 9000 auditors adds weight to this line of reasoning. The perception is that ISO auditors are professionals with significant education and experience. The respondents all conveyed the feeling that ISO registration is a meaningful process. The companies contacted had paid significant sums of money to achieve registration. It can be reasonably concluded that those expenditures were subjected to the normal review and justification criteria inherent in organizations that are upgrading the way they do business. The initial impetus may have come from marketing, but the respondents all made a strong case for the benefits derived by improvements in their quality assurance departments, brought about by ISO registration.

Regardless of whether a contractor cites direct or indirect costs, the conclusion of this researcher is that using ISO 9001 in place of MIL-Q-9858A is not reasonable justification for such additional costs.

The third conclusion of this study is:

3. The adoption of ISO 9002 in place of MIL-I-45208 will impact the cost for those companies currently operating under MIL-I-45208.

The comparison presented in Chapter III between ISO 9002 and MIL-I-45208 clearly shows that ISO 9002 is structurally and philosophically a different standard than MIL-I-45208. ISO 9002 takes ISO 9001 and deletes those paragraphs that apply to quality control of the design

process. ISO 9002 still has a continuous improvement element and stresses control of the process. MIL-I-45208 was summarized by many respondents as an end-item acceptance inspection. It does not attempt to integrate the quality assurance function into the entire process; it simply strives to detect defective material after it has been produced. The implementation of ISO 9002 in a company operating under MIL-I-45208 would require the formalization of procedures, and documentation of the entire process, leading up to end-item inspection. This increased documentation and control results in added costs, both immediate costs to establish the systems, and the continuing costs of maintenance. The trade-off to these costs should be the realization of lower scrap and rework charges that arise under an end-item inspection system. Regardless of possible offsetting benefits, a review of the differences between ISO 9002 and MIL-I-45208 shows that there is added cost in changing from MIL-I-45208 to ISO 9002.

The Contracting Officer who uses ISO 9002 as a contractual requirement must be prepared to deal with the added costs that will be incurred by this change to a contractor's quality assurance system.

The fourth conclusion of this study is:

4. The implementation of ISO 9000 Standards will still require the same type of amplifying policies and procedures that are currently used with MIL-STDS.

There is a widespread misconception among even knowledgeable quality assurance managers that MIL-Q-9858A and MIL-I-45208 are huge detailed documents more than an inch thick. In reality, both these MIL-STDS are brief concise documents that reference other standards and handbooks, resulting in layer upon layer of documents that detail the implementation of a quality assurance system commonly known as "MIL-Q." These layers of added definition and direction evolve and change in response to the problems experienced. The ISO standards, on the other hand, were first issued in 1987 and there has not been enough time for them to generate this layering. As discussed in Chapter II, the TC176 committee is currently working on changes and amplification of the basic ISO 9000 series of standards, and the layering effect will soon become apparent. The counterpart to many of these TC176 initiatives can be found in the handbooks and references associated with MIL-Q-9858A.

The fifth conclusion of this study is:

5. A requirement for ISO 9000 registration in a DoD contract would create resistance to that requirement from some DoD contractors.

As pointed out by one of the respondents to the telephone interview, some companies are receiving the information and level of quality they want from their current quality assurance system. These companies will not willingly bear the costs required to achieve ISO 9000 registration until

the benefits of registration are better defined and quantified.

The sixth conclusion of this study is:

6. The use of ISO 9000 requires a different philosophy regarding quality assurance than that required to operate under MIL-STDS.

The commitment of a company's top management to the major tenets of ISO 9000 is a requirement that must be satisfied with a published and actively-supported policy. Several of the respondents made it clear that prior to granting registration, ISO auditors look closely at the corporate management attitudes toward quality assurance. The ISO auditors were also described as "consultants" by one respondent, and several mentioned the impression that the ISO auditors were working with them to improve the overall process, rather than simply inspecting it for compliance. This fostering the attitude of continuous improvement by ISO is one of the key differences between ISO 9000 and MIL-STDS and it cannot be overemphasized. ISO standards require feedback from the user and continual monitoring of the production process to ensure it is within tolerance levels.

If ISO standards are to be used in place of MIL-STDS, this same change in philosophy from Government auditors would be necessary to ensure that maximum effectiveness is gained from the switch to ISO standards. Government auditors would have to focus their attention on aiding the contractor in

improving his process by identifying weak or out-of-tolerance areas. This approach to quality assurance is new to the Government, and has taken form in a program labeled In-plant Quality Evaluation (IQUE). IQUE embraces the idea of the Government Quality Assurance Representative (QAR) becoming a member of the contractor's team to ensure that a quality product is delivered to the Government. The implementation of ISO 9000 Standards would reinforce this philosophy and strengthen this new program.

C. RECOMMENDATIONS

The secondary objective of this study was to look at ISO 9000 and see how it could be implemented within the DoD contracting arena. It is assumed that DoD will adopt ISO 9000 Standards and it is the implementation of those standards that generates the following six recommendations.

The first recommendation of this study is:

1. DoD should define its policy of replacing MIL-Q-9858 with ISO 9001, and begin integrating it into DoD contracts. This integration should be accompanied by an education program for Contracting Officers covering the costs and benefits of ISO 9001, as compared to MIL-Q-9858A.

The quality assurance side of DoD, as represented by OSD(P&L), has decided that ISO 9001 is an improvement over MIL-Q-9858A and it wants to impose these standards on DoD contractors. This decision is based on several factors, but

a most important element to bear in mind is that imposing ISO 9001 on a contractor already using MIL-Q-9858A should not result in significant added cost. This change to ISO 9001 promises to hold benefits in better quality products, along with reducing the adversarial atmosphere that is prevalent in some industries between QARs and contractors. By accepting ISO 9001, contractors are aided in achieving standardization of a key element in their business, thus reducing the redundancy that contractors experience when trying to maintain two systems -- one for DoD and one for commercial markets.

To make the transition from a purely technical decision to implementing ISO 9001 in a contract will require that Contracting Officers be given a basic understanding of the impact this change will cause. If a contractor approaches a Contracting Officer about ISO 9001, it is incumbent on the Contracting Officer to provide a response based on at least a fundamental knowledge of the new system.

The education/training is not limited to Contracting Officers. DoD quality assurance personnel, especially QARs, need to be retrained in the manner in which they approach the subject of quality assurance. As pointed out in conclusion seven, imposition of ISO 9000 on a contractor requires acceptance of a new philosophy, which calls for better communication and cooperation between quality auditors and the production personnel involved.

The recommendation to implement ISO 9001 in contracts leads directly to the second recommendation:

2. DoD should train and educate their QARs in ISO 9000, and adopt and apply its philosophy to quality audits.

The support of IQUE, as mentioned in conclusion seven, is but one example of the benefit DoD could realize by actively supporting the retraining of QARs to ISO 9000 Standards. DoD has recognized that its quality operations in the past have not achieved the desired level of cooperation and support from contractors. ISO 9000 gives DoD an opportunity to improve both the contractor's and DoD's quality procedures by getting both sides to agree to use the same set of standards. Hopefully, both will learn to use ISO 9000 in a way that improves the production process, thereby improving quality.

The third recommendation of this study is meant to support an atmosphere of cooperation that ISO 9000 makes possible:

3. The idea of using ISO 9000 registrars as arbitrators in disputes between DoD and contractors should not be adopted.

This idea of finding an alternative disputes resolution (ADR) method for settling quality issues before they become legal issues, has appeal at first glance. The problem with using a registrar as an arbitrator lies in the risk of reinforcing the adversarial relationship between DoD and contractors. ISO standards support a goal of obtaining

feedback from customers and using it to improve the process. The use of ADR instead of open communication regarding problems puts DoD back into an adversarial role with contractors.

The introduction of registrars into dispute resolutions also means that a company is now faced with a new antagonistic relationship, forced by DoD regulation. This new relationship is between the company and the registrar. The idea behind ISO registration is to provide an experienced and helpful review of a quality assurance program, not to act as a third-party buffer between a company and its customers.

During the telephone interviews, it became clear that the quality managers and directors contacted felt any disputes regarding quality could be settled at a lower level, rather than by an outside third party. These same managers asserted that if DoD QARs were properly trained in ISO standards, the poor communication between them and contractor personnel would be reduced, since both sides should now have the same set of policies and procedures to use in resolving disputes.

This use of ISO 9000 to reduce friction is taken one step further in recommendation four by reducing the workload experienced by both the contractor and DoD personnel. The fourth recommendation is:

4. Successful completion of ISO registration should be equivalent to a satisfactory pre-award survey of a contractor's quality assurance system.

The ISO auditors use almost exactly the same procedure used during pre-award surveys by QARs and Administrative Contracting Officers. They review the policies and procedures of a company for adequacy, and then audit the quality assurance process to see if it is conforming to stated policy and procedures. DoD would better utilize its scarce resources by eliminating pre-award quality surveys, thereby reducing the workload, while gaining the benefit of experienced teams of highly trained professional auditors, doing the work of pre-award quality surveys at no cost to DoD. The ISO auditors registering companies to ISO 9000 Standards must themselves be audited and certified as acceptable registrars. This auditing and certification of registrars is currently based on European governmental oversight through the qualification process for a company to become certified as a registrar.

The fifth recommendation of this study is:

5. Impose ISO 9000 only in those contracts in which it makes sense.

ISO 9000 standards are designed for, and heavily weighted toward, the creation of a quality assurance system for production processes. The standards are written in such a way that implementation is much easier where the production process of the end item is well defined. As stated in the telephone surveys, and supported by a review of the standards, ISO 9000 is not easily applied to situations that require creative production processes.

The comparison of ISO 9002 to MIL-I-45208 also demonstrates that ISO standards may not be used as exact replacements for MIL-STDS. Imposing ISO 9002 on a contractor not used to anything but end-item inspection will result in added cost, as explained in conclusion three. If ISO 9002 is to be a contractual requirement, the cost impact needs to be acknowledged and addressed.

The sixth recommendation of this study is:

6. Implementation of ISO standards in DoD contracts must be done over a reasonable period of time.

Any move toward contractual requirements to use ISO 9000 Standards will take an extended period of time to phase in. There were only 225 companies registered to ISO 9000 at the time the telephone survey was made, and thus there are a great number of companies that have to learn about ISO 9000, and expend resources to implement it, before it could be taken as a DoD-wide requirement.

The phase-in period must be further extended if recommendation four, which calls for the use of registration as a means to reduce pre-award quality surveys, is fully implemented. Since most companies are not ISO registered, registration costs could conceivably create a barrier to competition; any use of registration should be as an alternative to existing procedures, to allow sufficient time for DoD contractors to analyze and decide if registration costs are worth the benefits. It is not reasonable to demand

ISO registration when some companies may not feel the need to change from their existing system. In addition, registrars are experiencing a demand for their services to register companies, that exceeds their capacity to supply.

D. ANSWERS TO RESEARCH QUESTIONS

The primary research question of this study is: **Should ISO 9000 be implemented within DoD and the Defense Industrial Base, and when implemented, how will it affect DoD contracting?**

The answer to this question is contained in the previously discussed conclusions and recommendations, but can be briefly summarized as follows:

1. Put ISO 9001 in place of MIL-Q-9858A in future contracts.

The cost impact of complying with ISO 9001 instead of MIL-Q-9858A for most contractors is negligible. At the same time, the benefits of adopting an improvement-oriented quality assurance attitude are great. The use of a standard quality assurance policy, aimed at continuous improvement for both commercial and DoD work, will result in economic savings to the contractor and better quality products for DoD.

2. Do not make it a contractual requirement that a contractor be *registered* to ISO standards.

There were only 225 companies in the U.S. that were registered at the time this study and survey was conducted.

This small number of ISO registered companies means that a registration requirement would create barriers to competition.

3. The primary impact of ISO 9000 will be to change the philosophy of DoD quality assurance programs from one of inspection to continuous improvement and prevention of poor quality products.

This change in philosophy will have both cost impact and benefits. The Contracting Officer needs to make a determination that the benefits outweigh the cost before advocating and supporting the use of ISO 9000. This determination needs to be made on a contract-by-contract basis. Answers to secondary research questions can be found throughout this study; they are briefly summarized below:

1. What is ISO 9000?

ISO 9000 is a set of quality assurance standards created to provide uniformity among the European Community, starting in 1992. These standards stress process control and are a step toward continuous improvement. Chapter II, Part B, presents a detailed explanation of each of the ISO 9000 Standards.

2. What are the similarities and differences between ISO standards and MIL-STDS?

Both sets of standards are process-control related, but ISO has a fundamentally different philosophy that stresses improvement and active involvement of production with quality

control issues. The differences between the two sets of standards are set forth in Chapter III of this study.

3. What is the policy of DoD with regards to ISO 9000?

Its stated policy is to move toward implementation of ISO standards in DoD contracts, but not to require registration. An in-depth review of DoD policy is presented in Chapter II, Part D, subpart 2.

4. What are the anticipated benefits from implementing ISO standards?

An improvement in the quality of products delivered to DoD is anticipated by changing the focus of quality assurance from end-item inspection to one of process control and feedback. The ISO standards provide DoD with the opportunity to assist contractors by implementing one standard that can be used in both commercial and defense work, with regards to quality assurance; it provides a step toward improvement of quality assurance systems. These benefits are evidenced in Chapter IV by the discussion and presentation of telephone interviews, conducted with quality managers of companies that have implemented ISO 9000.

5. What steps need to be taken to implement ISO standards?

Steps that should be taken in this area involve the following actions:

a. Educate and train personnel in ISO 9000 standards.

This education process will be aimed at primarily DoD and contractor QARs; but contracting and program management personnel will also need to have a general understanding of these new standards.

b. Invoke ISO 9001 in place of MIL-Q-9858A in DoD contracts, and provide the option of using ISO 9002 in place of MIL-I-45208.

The time has come to move ISO 9000 out the realm of quality assurance specialists and implement it in DoD contracts. Comparisons and analyses discussed in Chapters II and III clearly demonstrate that ISO 9000 is superior to the current DoD practices regarding quality assurance.

c. Assist communication with contractors as to ISO 9000 and inform the DoD industrial base concerning its existence.

There are still large segments of DoD and industry which are not aware of the ISO movement and what it means. In order to invoke fully ISO 9000, it becomes necessary to convert the DoD industrial base to its use.

The entire idea of ISO 9000 is so new that it easily gives rise to additional areas for further research. A few of these areas are delineated below:

E. AREAS FOR ADDITIONAL RESEARCH

Recommended topics for further research include:

1. A cost-benefit analysis for implementing ISO 9001 in place of MIL-Q-9858A, and a separate analysis of ISO 9002 rather than MIL-I-45208.

2. Study of education requirements for DoD personnel regarding ISO, and determination of the best means of satisfying those requirements.

3. Costs and benefits companies can expect from ISO registration.

4. Case study of a company that has implemented ISO standards to determine the actual benefits of using these standards.

APPENDIX A

LIST OF TELEPHONE INTERVIEWS

1. Aeroquip Corporation - Aerospace Division, Jackson, MI.
2. American Flange & Manufacturing Company Incorporated, Carol Stream, IL.
3. Arrow Electronics Incorporated, Brookhaven, NY.
4. Beloit Corporation - Paper Machine Division, Beloit, WI.
5. Brand-Rex Company, Willimantic, CT.
6. Copolymer Rubber & Chemical Company, Baton Rouge, LA.
7. Dentsply International Incorporated, Long Island City NY
8. Digital Equipment Corporation, Greenville, SC.
9. DSC Communications Corporation, Plano, TX.
10. Fischer & Porter, Warminister PA
11. Flo-Bend Incorporated, Tulsa OK
12. FMC Corporation - Fluid Control Division, Stephenville TX
13. The Foxboro Company, E. Bridgewater MA
14. General Electric Aircraft Engines, Lynn MA
15. Harnischfeger Corporation - Industrial and Electric Products Group, Milwaukee WI
16. Lutron Electronics, Coopersburg PA
17. Magnetrol International Incorportated, Downers Grove IL
18. Prime Computer Incorporated, Bedford MA
19. RAM Electronics, Long Beach CA
20. Reliable Automatic Sprinkler Company, Mount Vernon NY
21. Rohrback Cosasco Systems Incorporated, Santa Fe Springs CA
22. Rosemount Analytical, Orrville OH

23. STC Submarine Systems Incorportated, Portland OR

24. Valmet-Appleton Incorporated, Appleton WI

25. Yarway Corporation, Blue Bell PA

APPENDIX B

COMPARISON OF MIL-Q-9858A TO ISO 9001

MIL-Q-9858A	ISO 9001
No equivalency	**4 Quality system requirements** **4.1 Mangement resonsibility** **4.1.1. Quality policy** The supplier's management shall define and document its policy and objectives for, and commitment to, quality. The supplier shall ensure that this policy is understood, implemented and maintained at all levels in the organization. **4.1.2 Organization** **4.1.2.1** Responsibility and authority The responsibility, authority and the interrelation of all personnel who manage, perform and verify work affecting quality shall be defined; particularly for personnel who need the organizational freedom and authority to: a) initiate action to prevent the occurrence of product nonconformity; b) identify and record any product quality problems; c) initiate, recommend or provide solutions through designated channels; d) verify the implementation of solutions;

	e) control further processing, delivery or installation of nonconforming product until the deficiency or unsatisfactory condition has been corrected.
3.2 Initial Quality Planning. The contractor, during the earliest practical phase of contract performance, shall conduct a complete review of the requirements of the contract to identify and make timely provision for the special controls, processes, test equipments, fixtures, tooling and skills required for assuring product quality. This initial planning will recognize the need and provide for research, when necessary, to update inspection and testing techniques, instrumentation and correlation of inspection and test results with manufacturing methods and processes. This planning will also provide approprate review and action to assure compatibility of manufacturing, inspection, testing and documentation.results with manufacturing methods and processes. This planning will also provide appropriate review and action to assure compatibility of manufacturing, inspection, testing and documentation.	**4.1.2.2** Verification resources and personnel The supplier shall identify in-house verification requirements, provide adequate resources and assign trained personnel for verification activities. Verification activities shall include inspection, test and monitoring of the design, production, installation and servicing processes and/or product; design reviews and audits of the quality system, processes and/or product shall be carried out by personnel independent of those having direct responsibility for the work being performed. **4.1.2.3 Management representative** The supplier shall appoint a maangement representative who, irrespective of other responsibilities, shall have defined authority and responsibility for ensuring that the requirements of this International Standard are implemented and maintained.
3.1 Organization. Effective management for quality shall be clearly prescribed by the contractor. Personnel performing quality functions shall have sufficient, well-defined responsibility, authority and the organizational	**4.1.3 Management review** The quality system adopted to satisfy the requirements of this International Standard shall be reviewed at appropriate intervals by the supplier's management to ensure its

freedom to identify and evaluate quality problems and to initiate, recommend or provide solutions. Management regularly shall review the status and adequacy of the quality program. The term "quality program requirements" as used herein identifies the collective requirements of this specification. It does not mean that the fufillment of the requirements of this specification is the responsibility of any single contractor's organization, function or person.	continuing suitability and effectiveness. Records of such reviews shall be maintained (see 4.16). Note - Management reviews normally include assessment of the results of internal quality audits, but are carried out by, or on behalf of, the supplier's management, viz management personnel having direct responsibility for the system. (See 4.17)
No equivalency	**4.2 Quality system** The supplier shall establish and maintain a documented quality system as a means of ensuring that product conforms to specified requirements. This shall include a) the preparation of documented quality system procedures and instructions in accordance with the requirements of this international standard; b) the effective implementation of the documented quality system procedures and instructions. Note - In meeting specified requirements, timely consideration needs to be given to the following activities: a) the preparation of quality plans and a quality manual in accordance with the specified requirements; b) the identification and acquisition of any controls,

	processes, inspection equipment, fixtures, total production resources and skills that may be needed to achieve the required quality.; c) the updating, as necessary, of quality control, inspection and testing techniques, including the development of new instrumentation; d) the identification of any measurement requirement involving capability that exceeds the kown state of the art in sufficient time for the needed capability to be developed; e) the clarification of standards of accepatability for all features and requirements, including those which contain a subjective element; f) the compatibility of the design, the production process, installation, inspection and test procedures and the applicable documentation; g) the identification and preparation of qualtity records (see 4.16).
1.4 Relation to Other Contract Requirements. This specification and any procedure or document executed in implementation thereof shall be in addition to and not in derogation of other contract requirements. The quality program requirements set forth in this specification shall be satisfied in addition to all detail requirements contained in the statement of work or in other parts of the contract. The contractor is	**4.3 Contract review** The supplier shall establish and maintain procedures for contract review and for the coordination of these activities. Each constract shall be reviewed by the supplier to ensure that a) the requirements are adequately defined and documented;

responsible for compliance with all provisions of the contract and for furnishing specified supplies and services which meet all the requirements fo the contract. If any inconsistency exists between the contract schedule or its general provisions and this specification, the contract schedule and the general provisions shall control. The contractor's quality program shall be planned and used in a manner to support reliability effectively.	b) any requirements differing from those in the tender are resolved; c) the supplier has the capability to meet contractual requirements. Records of such contract reviews shall be maintained. Note - The contract review activities, interfaces and communication within the suppplier's organization should be coordinated with the purchaser's organization, as appropriate.
4.1 Drawings, Documentation and Changes. A procedure shall be maintained that concerns itself with the adequacy, the completeness and the currentness of drawings and with the control of changes in design. With respect to the currentness of drawings and changes, the contractor shall assure that requirements for the effectivity point of drawings and changes are met and that obsolete drawings and change requirements are removed from all points of issue and use. Some means of recording the effective points shall be employed and be available to the Government. With respect to design drawings and design specifications, a procedure shall be maintained that shall provide for the evaluation of the engineering adequacy and an evaluation of the adequacy of proposed changes. The evaluation shall encompass both the adequacy in relation to standard engineering and design practices and the adequacy with respect to the design and	**4.4 Design Control** **4.4.1 General** The supplier shall establish and maintain procedures to control and verify the design of the product in order to ensure that the specified requirements are met. **4.4.2 Design and development planning** The supplier shall draw up plans that identify the responsibility for each design and development activity. The plans shall describe or reference these activities and shall be updated as the design evolves. **4.4.2.1** Activity assignment The design and verification activities shall be planned and assigned to qualified personnel equipped with adequate resources. **4.4.2.2** Organizational and technical interfaces

purpose of the product to which the drawing relates.

With respect to supplemental specifications, process instructions, production engineering instructions, industrial engineering instructions and work instructions relating to a particlar design, the contractor shall be responsible for a review of thier adequacy, currentness and completeness. The quality program must provide complete coverage of all information necessary to produce an article in complete conformity with requirements of the design.

The quality program shall assure that there is complete compliance with contract requirements for proposing, approving, and effecting of engineering changes. The quality program shall provide for monitoring effectively the drawing changes of lesser importance not requiring approval by Government design authorities.

Delivery of correct drawings and change information to the Government in connection with data acquisition shall be an integral part of the quality program. This includes full compliance with contract requirements concerning rights and data both proprietary and other. The quality program's responsibility for drawings and changes extend to the drawings and changes provided by the subcontracors and vendors for the contract.

between different groups shall be identified and the necessary information documented, transmitted and regularly reviewed.

4.4.3 Design input

Design input requirements relating to the product shall be identified, documented and their selection reviewed by the supplier for adequacy.

Incomplete, ambiguous or conflicting requirements shall be resolved with those responsible for drawing up these requirements.

4.4.4 Design output

Design output shall be documented and expressed in terms of requirements, calculations and analyses.

Design output shall

a) meet the design input requirements;

b) contain or reference acceptance criteria;

c) conform to appropriate regulatory requirements whether or not these have been stated in the input information;

d) identify those characteristics of the design that are crucial to the safe and proper functioning of the product.

4.4.5 Design verification

The supplier shall plan, estabish, document and assign to competent personnel functions for verifying the design.

	Design verification shall establish that design output meets the design input requirement (see 4.4.4) by means of design control measures such as: a) holding and recording design reviews (see 4.16); b) undertaking qualification tests and demonstrations; c) carry out alternative calculations; d) comparing new design with a similar proven design, if available. **4.4.6 Design changes** The supplier shall establish and maintain procedures for the identification, documentation and appropriate review and approval of all changes and modifications.
No equivalency	**4.5 Document control** **4.5.1 Document approval and issue** The supplier shall establish and maintain procedures to control all documents and data that relate to the requirements of this International Standard. These documents shall be reviewed and approved for adequacy by authorized personnel prior to issue. This control shall ensure that a) the pertinent issues of appropriate documents are available at all locations where operations essential to the effective functioning of the quality system are performed;

	b) obsolete documents are promptly removed from all points of issue or use. **4.5.2 Document changes/ modifications** Changes to documents shall be reviewed and approved by the same functions/organizations that performed the original review and approval unless specifically designated otherwise. The designated organizations shall have access to pertinent background information upon which to base their review and approval. Where practicable, the nature of the change shall be identified in the document or the appropriate attachments. A master list or equivalent document control procedure shall be established to identify the current revision of documents inthe use of non-applicable documents. Documents shall be reissued after a practical number of changes have been made.
5. CONTROL OF PURCHASES **5.1 Responsibility.** The contractor is responsible for assuring that all supplies and services procured from his suppliers (subcontractos and vendors) conform to the contract requirements. The selection of sources and the nature and extent of control exercised by the contractor shall be dependent upon the type of supplies, his supplier's demonstrated capability to perform,	**4.6 Purchasing** **4.6.1 General** The supplier shall ensure that purchased product conforms to specified requirements. **4.6.2 Assessment of subcontractors** The supplier shall select subcontractors on the basis of their ability to meet subcontract requirements, includ-

~ and the quality evidence made available. To assure an adequate and economical control of such material, the contractor shall utilize to the fullest extent objective evidence of quality furnished by his suppliers. When the Government elects to perform inspection at a supplier's plant, such inspection shall not be used by contractors as evidence of effective control of quality by such suppliers. The inclusion of a product on the Qualified Products List only signifies that at one time the manufacturer made a product which met specification requirements. It does not relieve the contractor of his responsibility for furnishing supplies that meet all specification requirements or for the performance of specified inspections and tests for such material. The effectiveness and integrity of the control of quality by his suppliers shall be assessed and reviewed by the contractor at intervals consistent with the complexity and quantity of product. Inspection of products upon delivery to the contractor shall be used for assessment and review to the extent necessary for adequate assurance of quality. Test reports, inspection records, certificates and other suitable evidence relating to the supplier's control of quality should be used in the contractor's assessment and review. The contractor's responsibility for the control of purchases includes the establishment of a procedure for (1) the selection of qualified suppliers, (2) the transmission of applicable design and quality requirements in the Government contracts and associated tech-	ing quality requirements. The supplier shall establish and maintain records of acceptable sub-contractors (see 4.16). The selection of sub-contractors, and the type and extent of control exercised by the supplier, shall be dependent upon the type of product and, where appropriate, on records of subcontractor's previously demonstrated capability and performance. The supplier shall ensure that quality system controls are effective.

nical requirements, (3) the evaluation of the adequacy of procured items, and (4) effective provisions for early information feedback and correction of nonconformances.	
5.2 Purchasing Data. The contractor's quality program shall not be acceptable to the Government unless the contractor requires of his subcontractors a quality effort achieving control of the quality of the services and supplies which they provide. The contractor shall assure that all applicable requirements are properly included or referenced in all purchase orders for products ultimately to apply on a Government contract. The purchase order shall contain a complete description of the supplies ordered including, by statement or reference, all applicable requirements for manufacturing, inspecting, testing, packaging, and any requiremets for Government or contractor inspections, qualifications, or approvals. Technical requirements of the following nature must be included by statement or reference as a part of the required clear description: all pertinent drawings, engineering change orders,specifications (including inspection system or quality program requirements), reliability, safety, weight, or other special requirements, unusual test or inspection procedures or equipment and any special revision or model identification. The description of products ordered shall include a requirement for contractor inspection at the sub-contrator	**4.6.3 Purchasing data** Purchasing documents shall contain data clearly describing the product ordered, including, where applicable, a) the type, class, style, grade or other precise identification; b) the title or other positive identification, and applicable issue of specifications, drawings, process requirements, inspection instructions and other relevant technical data, including requirements for approval or qualification of product, procedures, process equipment and personnel; c) the title, number and issue of the quality system International Standard to be applied to the product. The supplier shall review and approve purchasing documents for adequacy of specified requirements prior to release. **4.6.4 Verification of purchased product** Where specified in the contract, the purchaser or his representative shall be afforded the right to verify at source or upon receipt that purchased product conforms to specified

or vendor source when such action is necessary to assure that the contractor's responsibility for complete assurance of product quality. Requirements shall be included for chemical and physical testing and recording in connection with the purchase of raw materials by his suppliers. The purchase orders must also contain a requirement for such suppliers to notify and obtain approval from the contractor of changes in design of the products. Necessary instructions should be provided when provision is made for direct shipment from the sub-contractor to Government activities.	requirements. Verification by the purchaser shall not absolve the supplier of the responsibility to provide acceptable product nor shall it preclude subsequent rejection. When the purchaser or his representative elects to carry out verification at the sub-contractor's plant, verification shall not be used by the supplier as evidence of effecive control of quality by the sub-contractor.
7.2 Government Property. **7.2.1 Government-furnished Material.** When material is furnished by the Government, the contractor's procedures shall include at least the following: a) Examination upon receipt, consistent with practicability to detect damage in transit; b) Inspection for completeness and proper type; c) Periodic inspection and precautions to assure adequate storage conditions and to guard against damage from handling and deterioration during storage; d) Functional testing, either prior to or after installation, or both, as required by contract to determine satisfactory operation; e) Identification and protection from improper use or disposition; and f) Verification of quantity.	**4.7 Purchaser supplied product** The supplier shall establish and maintain procedures for verification, storage and maintenance of purchaser supplied product provided for incorporation into the supplies. Any such product that is lost, damaged or is otherwise unsuitable for use shall be recorded and reported to the purchaser (see 4.16). Note - Verification by the supplier does not absolve the purchaser of the responsibility to provide acceptable product. found damaged, malfunctioning, or otherwise unsuitable for use. In the event of damage or malfucntioning during or after installation, the contractor shall determine and record probable cause and necessity for withholding material from use.

7.2.2 Damaged Government-furnished Material. The contractor shall report to the Government Representative anyGovernment-furnished material	
No equivalency	**4.8 Product identification and traceability** Where appropriate, the supplier shall establish and maintain procedures for identifying the product from applicable drawings, specificaitons or other documents, during all stages of production, delivery and installation. Where, and to the extent that, traceability is a specified requirement, individual product or batches shall have a unique identification. This identif-ication shall be recorded (see 4.16).
6.2 Production Processing and Fabrication. The contractor's quality program must assure that all machining, wiring, batching, shaping and all basic production operations of any type is accomplished under controlled conditions. Controlled condit-ions include documented work instructions, adequate product-ion equipment, and any special working environment. Documented work instructions are considered to be the criteria for much of the production, processing and fabrication work. These instructions are the criteria for acceptable or unacceptable "workmanship". The quality program will effectively monitor the issuance of and compliance with all of these work instructions. Physical examination, measure-ment or tests of the material or	**4.9 Process control** **4.9.1 General** The supplier shall identify and plan the production and, where applicable, installation processes which directly affect quality and shall ensure that these processes are carried out under controlled conditions. Controlled conditions shall include the following: a) documented work instructions defining the manner of production and installation, where the absence of such instructions would adversely affect quality, use of suitable production and installation equipment, suitable working environment, compliance with reference standards/codes and quality plans;

products processed is necessary for each work operation and must also be conducted under controlled conditions. If physical inspection of processed manterial is impossible or disadvantageous, indirect control by monitoring processing methods, equipment and personnel shall be provided. Both physical inspection and process monitoring shall be provided when control is inadequate without both, or when contract or specification requires both.	b) monitoring and control of suitable process and product characteristics during production and installation; c) the approval of processes and equipment, as appropriate; d) criteria for workmanship which shall be stipulated, to the greatest practicable extent, in written standards by means of representative samples.
Inspection and monitoring of processed material or products shall be accomplished in any suitable manner selected by the contractor. Methods of inspection and monitoring shall be corrected any time their unsuitability with reasonable evidence is demonstrated. Adherence to selected methods for inspection and monitoring shall be complete and continous. Corrective measures shall be takentaken when noncompliance occurs. Inspection by machine operators, automated inspection gages, moving line or lot sampling, setup or first piece approval, production line inspection station, inspection or test department, roving inspectors - any other type of inspection - shall be employed in any combination desired by the contractor which will adequately and efficiently protect product quality and the integrity of processing. Criteria for approval and rejection shall be provided for all inspection of product and monitoring of methods, equipment, and personnel. Means for	**4.9.2 Special processes** These are processes, the results of which cannot be fully verified by subsequent inspection and testing of the product and where, for example, processing deficiencies may become apparent only after the product is in use. Accordingly, continuous monitoring and/or compliance with documented procedures is required to ensure that the specified requirements are met. These processes shall be qualified and shall also comply with requirements of 4.9.1. Records shall be maintained for qualified processes, equipment and personnel, as appropriate.

identifying approved and rejected product shall be provided. Certain chemical, metallurgical, biological, sonic, electronic, and radiological processes are of so complex and specialized a nature that much more than the ordinary detailing of work documentation is required. In effect, such processing may require an entire work specification as contrasted with the normal plant-wide standard production control issuances such as job operation routing books and the like. Tests of the material or products processed is necessary for each work operation and must also be conducted under controlled conditions. If physical inspection of processed material is impossible or disadvantageous, indirect control by monitoring porcessing methods, equipment and personnel shall be provided. Both physical inspect these special processes, the contractors' quality program shall assure that the process control procedures or specifications are adequate and that processing environments and the certifying, inspection, authorization and monitoring of such processes to the special degree necessary for these ultraprecise and super-complex work functions are provided.	

6.1 Materials and Materials Contol. Supplier's materials and products shall be subjected to inspection upon receipt to the extent necessary to assure conformance to technical requirements. Receiving inspection may be adjusted upon the basis of the quality assurance program exercised by the suppliers. Evidence of the suppliers satisfactory control of quality may be used to adjust the amount and kind of receiving inspection. The quality program shall assure that raw materials to be used in fabrication or processing of products conforms to the applicable physical, chemical, and other technical requirements. Laboratory testing shall be employed as necessary. Suppliers shall be required by the contractor's quality program to exercise equivalent control of the raw materials utilized in the production of the parts and items which they supply to the contractor. Raw material awaiting testing must be separately identified or segregated from already tested and approved material but can be released for initial production, providing that identification and control is maintained. Material tested and approved must be kept identified until such time as its identity is necessarily obliterated by processing. Controls will be established to prevent the inadvertent use of material failing to pass tests.	**4.10 Inspection and testing** **4.10.1 Receiving inspection and testing** **4.10.1.1** The supplier shall ensure that incoming product is not used or processed (except in the circumstances described in 4.10.2) until it has been inspected or otherwise verified as conforming to specified requirements. Verification shall be in accordance with the quality plan or documented procedures. **4.10.1.2** Where incoming product is released for urgent production purposes, it shall be positively identified and recorded (see 4.16) in order to permit immediate recall and replacement in the event of nonconformance to specified requirements. Note - In determining the amount and nature of receiving inspection, consideration should be given to the control exercised at source and documented evidence of quality conformance provided.

Excerpts from 6.2 Production Processing and Fabrication	**4.10.2 In-process inspection and testing**
Physical examination, measurement or tests of the material or products processed is necessary for each work operation and must also be conducted under controlled conditions. If physical inspection of processed material is impossible or disadvantageous, indirect control by monitoring porcessing methods, equipment and personnel shall be provided. Both physical inspection and process monitoring shall be provided when control is inadequate without both, or when contract or specification requires both. Inspection by machine operators, automated inspection gages, moving line or lot sampling, setup or first piece approval, production line inspection station, inspection or test department, roving inspectors - any other type of inspection - shall be employed in any combination desired by the contractor which will adequately and efficiently protect product quality and the integrity of processing. Criteria for approval and rejection shall be provided for all inspection of product and monitoring of methods, equipment, and personnel. Means for identifying approved and rejected product shall be provided.	The supplier shall a) inspect, test and identify product as required by the quality plan or documented procedures; b) establish product conformance to specified requirements by use of process monitoring and control methods; c) hold product until the required inspection and tests have been completed or necessary reports have been received and verified except when product is released under positive recall procedures (see 4.10.1). Release under positive recall procedures shall not preclude the activities outlined in 4.10.2a); d) identify nonconforming product.
6.3 Completed Item Inspection and Testing. The quality program shall assure that there is a system for final inspection and test of completed products. Such testing shall provide a measure of the overall quality of the completed product and shall be	**4.10.3 Final inspection and testing** The quality plan or documented procedures for final inspection and testing shall require that all specified inspection and tests, including those specif-

performed so that it simulates, to a sufficient degree, product end use and functioning. Such simulation frequently involves appropriate life and endurance tests and qualification testing. Final inspection and testing shall provide for reporting to designers any unusual difficulties, deficiencies or questionable conditions. When modifications, repairs or replacements are required after final inspection or testing, there shall be reinspection and retesting of any characteristics affected.	ied either on receipt of product or in-process, have been carried out and that the data meets specified requirements. The supplier shall carry out all final inspection and testing in accordance with the quality plan or documented procedures to complete the evidence of conformance of the finished product to the spec-ified requirements. No product shall be despatched until all the activities specified in the quality plan or documented procedures have been satisfactorily completed and the associated data and documentation is available and authorized. **4.10.4 Inspection and test records** the supplier shall establish and maintain records which give evidence that the product has passed inspection and/or test with defined acceptance criteria (see 4.16).
4.2 Measuring and Testing Equipment. The contractor shall provide and maintain gages and other measuring and testing devices necessary to assure that suppliers conform to technical requirements. These devices shall be calibrated against certified measurement standards which have known vaid relationships to national standards at estblished periods to assure continued accuracy. The objective is to assure that inspection and test equipment is adjusted, replaced or repaired before it becomes inaccurate. The calibration of measuring and testing equipment shall be in	**4.11 Inspection, measuring and test equipment** The supplier shall control, calibrate and maintain inspection, measuring and test equipment, whether owned by the supplier, on loan, or provided by the purchaser, to demonstrate the conformance of product to the specified requirements. Equipment shall be used in a manner which ensures that measurement uncertainty is known and is consistent with the required measurement cap-ability.

conformity with military specification MIL-C-45662. In addition, the contractor shall insure the use of only such subcontractor and vendor sources that depend upon calibration systems which effectively control the accuracy of measuring and testing equipment.	The supplier shall a) identify the measurements to be made, the accuracy required and select the appropriate inspection, measuring and test equipment; b) identify, calibrate and adjust all inspection, measuring and test equipment and devices that can affect product quality at prescribed intervals, or prior to use, against certified equipment having a known valid relationship to nationally recognized standards - where no such standards exist, the basis used for cal-ibration shall be documented; c) establish, document and maintain calibration procedures, including details of equipment type, identification number, location, frequency of checks, check method, acceptance criteria and the action to be taken when results are unsatisfactory; d) ensure that the inspection, measuring and test equipment is capable of the accuracy and precision necessary; e) identify inspection, meas-uring and test equipment with a suitable indicator or approved identification record to show the calibration status; f) maintain calibration records for inspection, measuring and test equipment (see 4.16); g) assess and document the validity of previous inspect-ion and test results when inspection, measuring and test

	h) ensure that the environmental conditions are suitable for the calibration, inspections, measurements and tests being carried out; i) insure that the handling, preservation and storage of inspection, measuring and test equipment is such that the accuracy and fitness for use is maintained; j) safeguard inspection, measuring and test facilities, including both test hardware and test software, from adjust-ments which would invalidate the calibration setting.
4.3 Production Tooling Used as Media of Inspection. When production jigs, fixtures, tooling masters, templates, patterns and such other devices are used as media of inspection, they shall be proved for accuracy prior to release for use. These devices shall be proved again for accuracy at intervals formally established in a manner to cause their timely adjustment, replacement or repair prior to becoming inaccurate.	Where test hardware (e.g. jigs, fixtures, templates, patterns) or test software is used as suitable forms of inspection, they shall be checked to prove that they are capable of verifying the acceptability of product prior to release for use during production and installation and shall be re-checked at prescribed intervals. The supplier shall establish the extent and frequency of such checks and shall maintain records as evidence of control (see 4.16). Measurement design data shall be made available, when required by the purchaser or his representative, for verification that it is functionally adequate.
6.7 Indication of Inspection Status. The contractor shall maintain a positive system for identifying the inspection status of products. Identification may be accomplished by means of stamps, tags, routing cards, move tickets, tote box cards or other normal control devices. Such controls shall be	**4.12 Inspection and test status** The inspection and test status of product shall be identified by using markings, authorized stamps, tags, labels, routing cards, inspection records, test software, physical location or other suitable means, which indicate the conformance or

of a design distinctly different from Government inspection identification.	nonconformance of product with regard to inspection and tests performed. The identification of inspection and test status shall be maintained, as nec-essary, throughout production and installation of the product to ensure that only product that has passed the required inspections and tests is dis-patched, used or installed. Records shall identify the in-spection authority responsible for the release of conforming product (see 4.16).
6.5 Nonconforming Material. The contractor shall establish and maintain an effective and positive system for controlling nonconforming material, includ-ing procedures for its identi-fication, segregation, and disposition. Repair or rework of nonconforming material shall be in accordance with documented procedures acceptable to the Government. The acceptance of nonconforming supplies is a pre-rogative of and shall be as pre-scribed by the Government and may involve a monetary adjust-ment. All nonconforming supplies shall be positively identified to prevent unauthorized use, shipment and intermingling with conforming supplies. Holding areas or procedures mutually agreeable to the contractor and the Government Representative shall be provided by the contractor. The contractor shall make known to the Government upon request the data associated with the costs and losses in connection with scrap and with rework necessary to reprocess nonconforming material to make it conform completely.	**4.13 Control of nonconforming product** The supplier shall establish and maintain procedures to ensure that product that does not conform to specified requirements is prevented from inadvertent use or installat-ion. Control shall provide for identification, documentation, evluation, segregation (when practical), disposition of nonconforming product and for notification to the functions concerned. **4.13.1 Nonconfomity review and disposition** The responsibility for review and authority for the disposition of nonconforming product shall be defined. Nonconforming product shall be reviewed in accordance with documented procedures. It may be a) reworked to meet the specified requirements, or b) be accepted with or with-out repair by concession, or

	c) re-graded for alternative applications, or d) rejected or scrapped. Where required by the contract, the proposed use or repair of product (see 4.13.1b) which does not conform to specified requirements shall be reported for concession to the purchaser or his representative. The description of nonconformity that has been accepted, and of repairs, shall be recorded to denote the actual condition (see 4.16). Repaired and reworked product shall be re-inspected in accordance with documented procedures.
3.5 Corrective Action. The quality program shall detect promptly and correct assignable conditions adverse to quality. Design, purchasing, manufacturing, testing or other operations which could result in or have resulted in defective supplies, services, facilities, technical data, standards or other elements of contract performance which could create excessive losses or costs must be identified and changed as a result of the quality program. Corrective action will extend to the performance of all suppliers and vendors and will be responsive to data and product forwarded from users. Corrective action shall include as a minimum: a) Analysis of data and examination of product scrapped or reworked to determine extent and causes; b) Analysis of trends in processes or performance of work to prevent nonconforming product; and	**4.14 Corrective action** The supplier shall establish, document and maintain procedures for a) investigating the cause of nonconforming product and the corrective action needed to prevent recurrence; b) analysing all processes, work operations, concessions, quality records, service reports and customer complaints to detect and eliminate potent-ial causes of nonconforming product; c) initiating preventive actions to deal with problems to a level corresponding to the risks encountered; d) applying controls to ensure that corrective actions are taken and that they are effective;

c) Introduction of required improvements and corrections, aninitial review of the adequacy of such measures and monitoring of the effectiveness of correct-ive action taken.	e) implementing and recording changes in procedures resulting from corrective action.
6.4 Handling, Storage and Delivery. The quality program shall provide for adequate work and inspection instructions for handling, storage, preservation, packaging, and shipping to pro-tect the quality of products and prevent damage, loss, deteriora-tion, degradation, or substitut-ion of products. With respect to handling, the quality program shall require and monitor the use of procedures to prevent handling damage to articles. Handling procedures of this type include the use of special crates, boxes, containers, tran-sportation vehicles and any other facilities for materials handling. Means shall be pro-vided for any necessary protect-ion against deterioration or damage to products in storage. Periodic inspection for the pre-vention and results of such deterioration or damage shall be provided. Products subject to deterioration or corrosion dur-ing fabrication or interim stor-age shall be cleaned and preserved by methods which will protect against such deterior-ation or corrosion. When nec-essary, packaging designing and packaging shall include means for accommodating and maintain-ing crucial environments within packages, e.g., moisture content levels, gas pressures. The quality program shall assure that when such packaging envi-ronments must be maintained, packages are labeled to indicate this condition. The quality program shall monitor shipping	**4.15 Handling, storage, packaging and delivery** **4.15.1 General** The supplier shall establish, document and maintain proced-ures for handling, storage, packaging and delivey of product. **4.15.2 Handling** The supplier shall provide methods and means of handling that prevent damage or deter-ioration. **4.15.3 Storage** The supplier shall provide sec-ure storage areas or stock rooms to prevent damage or det-erioration of product, pending use or delivery. Appropriate methods for authorizing receipt and the despatch to and from such areas shall be stipulated. In order to detect deteriorat-ion, the condition of product in stock shall be assessed at appropriate intervals. **4.15.4 Packaging** The supplier shall control packing, preservation and mark-ing processes (including mater-ials used) to the extent nec-essary to ensure conformance to specified requirements and shall identify, preserve and segregate all product from the time of receipt until the sup-plier's responsibility ceases.

work to assure that products shipped are accompanied with required shipping and technical documents and that compliance with Interstate Commerce Commission rules and other applicable shipping regulations is effected to assure safe arrivaland identification at destination. In compliance with contractual requirements, the quality program shall include monitoring provisions for protection of the quality of products during transit.	**4.15.5 Delivery** The supplier shall arrange for the protection of the quality of product after final inspection and test. Where contractually specified, this protection shall be extended to include delivery to destination.
3.4 Records. The contractor shall maintain and use any records or data essential to the economical and effective operation of his quality program. These records shall be available for review by the Government Representative and copies of individual records shall be furnished him upon request. Records are considered one of the principal forms of objective evidence of quality. The quality program shall assure that records are complete and reliable. Inspection and testing records shall, as a minimum, indicate the nature of the observations together with the number of observations made and the number and type of deficiencies found. Also, records for monitoring work performance and for inspection and testing shall indicate the acceptability of work or products and the action taken in connection with deficiencies. the quality program shall provide for the analysis and use of records as a basis for management action.	**4.16 Quality Records** The supplier shall establish and maintain procedures for identification, collection, indexing, filing, storage, maintenance and disposition of quality records. Quality records shall be maintained to demonstrate achievement of the required quality and the effective operation of the quality system. Pertinent subcontractor quality records shall be an element of these data. All quality records shall be legible and identifiable to the product involved. Quality records shall be stored and maintained in such a way that they are readily retrievable in facilities that provide a suitable environment to minimize deterioration or damage and to prevent loss. Retention times of quality records shall be established and recorded. Where agreed contractually, quality records shall be made available for evaluation by the purchaser or his representative for an agreed period.

No equivalency	**4.18 Training** The supplier shall establish and maintain procedures for identifying the training needs and provide for the training of all personnel performing activities affecting quality. Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and/or experience, as required. Appropriate records of training shall be maintained (see 4.16).
No equivalency	**4.19 Servicing** Where servicing is specified in the contract, the supplier shall estabish and maintain procedures for performing and verifying that serving meets the specified requirements.
6.6. Statistical Quality Control and Analysis. In addition to statistical methods required by the contract, statistical planning, analysis, tests and quality control procedures may be utilized whenever such procedures are suitable to maintain the required control of quality. Sampling plans may be used when tests are destructive, or when the records, inherent characteristics of the product or the noncritical application of the product indicate that a reduction in inspection or testing can be achieved without jeopardizing quality. The contractor may employ sampling inspection in accordance with applicable military standards and sampling plans (e.g., from MIL-STD-105, MIL-STD-414, or Handbooks H 106, 107 and 108). If the contractor uses other sampling plans, they shall be	**4.20 Statistical techniques** Where appropriate, the supplier shall establish procedures for identifying adequate statistical techniques required for verifying the acceptability of process capability and product characteristic

subject to review by the cognizant Government Representative. Any sampling plan used shall provide valid confidence and quality levels.	
No equivalancy	**4.17 Internal quality audits** The supplier shall carry out a comprehensive system of planned and documented internal quality audits to verify whether quality activities comply with planned arrangements and to determine the effectiveness of the quality system. Audits shall be scheduled on the basis of the status and importance of the activity. The audits and follow-up actions shall be carried out in accordance with documented procedures. The results of the audits shall be documented and brought to the attention of the personnel having responsibility in the area audited. The management personnel responsible for the area sahll take timely corrective action on the deficiencies found by the audit (see 4.1.3).
7.2.3 Bailed Property. The contractor shall, as required by the terms of the Bailment Agreement, establish procedures for the adequate storage, maintenance and inspection of bailed Government property. Records of all inspections and maintenance performed on bailed property shall be maintained. These procedures and records shall be subject to review by the Government Representative.	No equivalency

3.6 Costs Related to Quality. The contractor shall maintain and use quality cost data as a management element of the quality program. These data shall serve the purpose of identifying the cost of both the prevention and correction of nonconforming supplies (e.g., laobr and material involved in material spoilage caused by defective work, correction of defective work and for quality control exercised by the contractor at subcontractor's or vendor's facilities). The specified quality cost data to be maintained and used will be determined by the contractor. These data shall, on request, be identified and made available for "on site" review by the Government Representative.	No equivalency
4.4 Use of Contractor's Inspection Equipment. The contracrtor's gages, measuring and testing devices shall be made available for use by the Government when required to determine conformance with contract requirements. If conditions warrant, contractor's personnel shall be made available for operation of such devices and for verification of their accuracy and condition.	No equivalency

7.1 Government Inspection at Subcontractor of Vendor Facilities. The Governments reserves the right to inspect at source supplies or services not manufactured or performed with the contractor's facility. Government inspection shall not constitute accepance; nor shall it in any way replace contractor inspection or otherwise relieve the contractor of his responsibility to furnish an acceptable end item. The purpose of this inspection is to assist the Government Representative at the contractor's facility to determine the conformance of supplies or services with contract requirements. Such inspection can only be requested by or under authorization of the Government Representative. When Government inspection is required, the contractor shall add to his purchasing document the following statement: "Government inspection is required prior to shipment from your plant. Upon receipt of this order, promptly notify the Government Representative who normally services your plant so that appropriate planning for Government inspection can be accomplished." When, under authorization from the Government Representative, copies of the purchasing document are to be furnished directly by the subcontractor or vendor to the Government Representative at his facility rather than through Government Channels, the contractor shall add to his purchasing document a statement substantially as follows:	No equivalency

"On receipt of this order, promptly furnish a copy to the Government representative who normally services your plant, or, if none, to the nearest Army, Navy, Air Force, or Defense Supply Agency inspection office. In the event the representative or office cannot be located, our purchasing agent should be notified immediately." All documents and referenced data for purchases applying to a Government contract shall be available for review by the Government Representative to determine compliance with the requirements for the control of such purchases. Copies of purchasing documents for Government purposes shall be furnished in accordance with the instructions of the Government Representative. The contractor shall make available to the Government Representative reports of any nonconformance found on Government source inspected supplies and shall (when requested) require the supplier to coordinate with his Government Representative on corrective action.	

APPENDIX C

COMPARISON OF MIL-I-45208 TO ISO 9002

MIL-I-45208	ISO 9002
1.1 Scope. This specification establihes requirements for contractors' inspection systems. These requirements pertain to the inspections and tests necessary to substantiate product conformance to drawings, specifications and contract requirements and to all inspections and tests required by the contract. These requirements are in addition to those inspections and tests set forth in applicable specifications and other contractual documents.	**4 Quality system requirements** **4.1 Mangement responsibility** **4.1.1. Quality policy** The supplier's management shall define and document its policy and objectives for, and commitment to, quality. The supplier shall ensure that this policy is understood, implemented and maintained at all levels in the organization.
3. REQUIREMENTS **3.1 Contractor Resonsibilities.** The contractor shall provide and maintain an inspection system which will assure that all supplies and services submitted to the Government for acceptance conform to contract requirements whether manufactured or processed by the contractor, or procured from subcontractors or vendors. The contractor shall perform or have performed the inspections and tests required to substantiate product conformance to drawing, specifications and contract requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The contractor's inspection system shall be documented and shall be available for review by the Government Representative prior to the initiation of production and throughout the life of the	**4.1.2 Organization** **4.1.2.1** Responsibility and authority The responsibility, authority and the interrelation of all personnel who manage, perform and verify work affecting quality shall be defined; particularly for personnel who need the organizational freedom and authority to a) initiate action to prevent the occurence of product nonconformity; b) identify and record any product quality problems; c) initiate, recommend or provide solutions through designated channels; d) verify the implementation of solutions;

contract. The Government at its option may furnish written of the acceptability or nonacceptability of the inspection system. The contractor shall notify the Government Representative in writing of any change to his inspection system. The inspection system shall be subject to disapproval if changes thereto would result in nonconforming product.	e) control further processing, delivery or installation of nonconforming product until the deficiency or unsatisfactory condition has been corrected.
No equivalency	**4.1.2.2** Verification resources and personnel The supplier shall identify in-house verification requirements, provide adequate resources and assign trained personnel for verification activities (see 4.17). Verification activities shall include inspection, test and monitoring of the design, production, installation and servicing processes and/or product; design reviews and audits of the quality system, processes and/or product shall be carried out by personnel independent of those having direct responsibility for the work being performed. **4.1.2.3 Mangement representative** The supplier shall appoint a management representative who, irrespective of other resonsibities, shall have defined authority and responsibility for ensuring that the requirements of this International Standard are implemented and maintained.
	4.1.3 Management review The quality system adopted to satisfy the requirements of this International Standard shall be

	reviewed at appropriate intervals by the supplier's management to ensure its continuing suitability and effectiveness. Records of such reviews shall be maintained (see 4.16). Note - Management reviews normally include assessment of the results of internal quality audits, but are carried out by, or on behalf of, the supplier's management, viz management personnel having direct responsibility for the system. (See 4.17)
No equivalency	**4.2 Quality system** The supplier shall establish and maintain a documented quality system as a means of ensuring that product conforms to specified requirements. This shall include a) the preparation of documented quality system procedures and instructions in accordance with the requirements of this international standard; b) the effective implementation of the documented quality system procedures and instructions. Note - In meeting specified requirements, timely consideration needs to be given to the following activities: a) the preparation of quality plans and a quality manual in accordance with the specified requirements; b) the identification and acquisition of any controls, processes, inspection equipment,

	fixtures, total production resources and skills that may be needed to achieve the required quality.; c) the updating, as necessary, of quality control, inspection and testing techniques, including the development of new instrumentation; d) the identification of any measurement requirement involving capability that exceeds the kown state of the art in sufficient time for the needed capability to be developed; e) the clarification of standards of accepatability for all features and requirements, including those which contain a subjective element; f) the compatibility of the design, the production process, installation, inspection and test procedures and the applicable documentation; g) the identification and preparation of qualtity records (see 4.16).
1.4 Relation to Other Contract Requirements. The inspection system requirements set forth in this specification shall be satisfied in addition to all detail requirements contained in the statement of work or in other parts of the contract. The contractor is responsible for compliance with all provisions of the contract and for furnishing specified articles which meet all the requirements of the contract. To the extent of any inconsistency between the contract schedule or its general	**4.3 Contract review** The supplier shall establish and maintain procedures for contract review and for the coordination of these activities. Each constract shall be reviewed by the supplier to ensure that a) the requirements are adequately defined and documented;

provisions and this specification the contract schedule and the general provisions shall control.	b) any requirements differing from those in the tender are resolved; c) the supplier has the capability to meet contractual requirements. Records of such contract reviews shall be maintained. Note - The contract review activities, interfaces and communication within the suppplier's organization should be coordinated with the purchaser's organization, as appropriate.
3.2 Documentation, Records and Corrective Action. **3.2.1 Inspection and testing Documentation.** Inspection and testing shall be prescribed by clear, complete and current instructions. The instructions shall assure inspection and test of materials, work in process and completed articles as required by the item specification and the contract. In addition, criteria for approval and rejection of product shall be included.	**4.4 Document control** **4.4.1 Document approval and issue** The supplier shall establish and maintain procedures to control all documents and data that relate to the requirements of this International Standard. These documents shall be reviewed and approved for adequacy by authorized personnel prior to issue. This control shall ensure that: a) the pertinent issues of appropriate documents are available at all locations where operations essential to the effective functioning of the quality system are performed; b) obsolete documents are promptly removed from all points of issue or use.

No equivalency	**4.4.2 Document changes/ modifications** Changes to documents shall be reviewed and approved by the same functions/organizations that performed the original review and approval unless specifically designated otherwise. The designated organizations shall have access to pertinent background information upon which to base their review and approval. Where practicable, the nature of the change shall be identified in the document or the appropriate attachments. A master list or equivalent document control procedure shall be established to identify the current revision of documents in order to preclude the use of non-applicable documents. Documents shall be reissued after a practical number of changes have been made.
No equivalency	**4.5 Purchasing** **4.5.1 General** The supplier shall ensure that purchased product conforms to specified requirements. **4.5.2 Assessment of subcontractors** The supplier shall select subcontractors on the basis of their ability to meet subcontract requirements, including quality requirements. The supplier shall establish and maintain records of acceptable subcontractors (see 4.16). The selection of subcontractors, and the type and extent of control exercised by

	the supplier, shall be dependent upon the type of product and, where appropriate, on records of subcontractor's previously demonstrated capability and performance. The supplier shall ensure that quality system controls are effective.
3.11.2 Purchasing Documents. When, under authorization of the Government Representative, copies of the purchasing document are to be furnished directly by the subcontractor or vendor to the Government Representative at his facility rather than through Government chanels, the contractor shall add to his purchasing document a statement substantially as follows: "On receipt of this order, promptly furnish a copy to the Government Representative who normally services your plant or, if none, to the nearest Army Navy, Air Force, or Defense Supply Agency inspection office. In the event the representative or office cannot be located, our purchasing agent should be notified immediately." **3.11.3 Reference Data.** All documents and referenced data for purchases applying to a Government contract shall be available for review by the Government Representative to determine compliance with the requirements for the control of such purchases. Copies of purchasing documents required for Government inspection purposes shall be furnished in accordance with the instructions of the Government Representative.	**4.5.3 Purchasing data** Purchasing documents shall contain data clearly describing the product ordered, including, where applicable, a) the type, class, style, grade or other precise identification; b) the title or other positive identification, and applicable issue of specifications, drawings, process requirements, inspection instructions and other relevant technical data, including requirements for approval or qualification of product, procedures, process equipment and personnel; c) the title, number and issue of the quality system International Standard to be applied to the product. The supplier shall review and approve purchasing documents for adequacy of specified requirements prior to release.

6.1 Order Data. Procurement documents should specify the title, number and date of this specification.	
No equivalency	**4.5.4 Verification of purchased product** Where specified in the contract, the purchaser or his representative shall be afforded the right to verify at source or upon receipt that purchased product conforms to specified requirements. Verification by the purchaser shall not absolve the supplier of the responsibility to provide acceptable product nor shall it preclude subsequent rejection. When the purchaser or his representative elects to carry out verification at the sub-contractor's plant, verification shall not be used by the supplier as evidence of effecive control of quality by the sub-contractor.
7.2 Government Property. **7.2.1 Government-furnished Material.** When material is furnished by the Government, the contractor's procedures shall include at least the following: a) Examination upon receipt, consistent with practicability to detect damage in transit; b) Inspection for completeness and proper type; c) Periodic inspection and precautions to assure adequate storage conditions and to guard against damage from handling and deterioration during storage;	**4.6 Purchaser supplied product** The supplier shall establish and maintain procedures for verification, storage and maintenance of purchaser supplied product provided for incorporation into the supplies. Any such product that is lost, damaged or is otherwise unsuitable for use shall be recorded and reported to the purchaser (see 4.16). Note - Verification by the supplier does not absolve the purchaser of the responsibility to provide acceptable product.

d) Functional testing, either prior to or after installation, or both, as required by contract to determine satisfactory operation; e) Identification and protection from improper use or disposition; and f) Verification of quantity. **7.2.2 Damaged Government-furnished Material.** The contractor shall report to the Government Representative any Government-furnished material found damaged, malfunctioning, or otherwise unsuitable for use. In the event of damage or malfucntioning during or after installation, the contractor shall determine and record probable cause and necessity for withholding material from use.	
No equivalency	**4.7 Product identification and traceability** Where appropriate, the supplier shall establish and maintain procedures for identifying the product from applicable drawings, specificaitons or other documents, during all stages of production, delivery and installation. Where, and to the extent that, traceability is a specified requirement, individual product or batches shall have a unique identification. This identification shall be recorded (see 4.16).
3.4 Process Controls. Process control procedures shall be an integral part of the inspection system when such inspections are a part of the specification or the contract.	**4.8 Process control** **4.8.1 General** The supplier shall identify and plan the production and, where

	applicable, installation processes which directly affect quality and shall ensure that these processes are carried out under controlled conditions. Controlled conditions shall include the following: a) documented work instructions defining the manner of production and installation, where the absence of such instructions would adversely affect quality, use of suitable production and installation equipment, suitable working environment, compliance with reference standards/codes and quality plans; b) monitoring and control of suitable process and product characteristics during production and installation; c) the approval of processes and equipment, as appropriate; d) criteria for workmanship which shall be stipulated, to the greatest practicable extent, in written standards by means of representative samples.
No equivalency	**4.8.2 Special processes** These are processes, the results of which cannot be fully verified by subsequent inspection and testing of the product and where, for example, processing deficiencies may become apparent only after the product is in use. Accordingly, continuous monitoring and/or compliance with documented procedures is required to ensure that the specified requirements are met. These processes shall be qualified and shall also comply with requirements of 4.9.1.

	Records shall be maintained for qualified processes, equipment and personnel, as appropriate.
3.12 Receiving Inspection. Subcontracted or purchased supplies shall be subjected to inspection after receipt, as necessary, to assure conformance to contract requirements. The contractor shall report to the Government Representative any nonconformance found on Government source-inspected supplies and shall require his supplier to coordinate with his Government Representative on corrective action.	**4.9 Inspection and testing** **4.9.1 Receiving inspection and testing** **4.9.1.1** The supplier shall ensure that incoming product is not used or processed (except in the circumstances described in 4.10.2) until it has been inspected or otherwise verified as conforming to specified requirements. Verification shall be in accordance with the quality plan or documented procedures. **4.9.1.2** Where incoming product is released for urgent production purposes, it shall be positively identified and recorded (see 4.16) in order to permit immediate recall and replacement in the event of nonconformance to specified requirements. Note - In determining the amount and nature of receiving inspection, consideration should be given to the control exercised at source and documented evidence of quality conformance provided.
3.10 Inspection Provisions. Alternative inspection procedures and inspection equipment may be used by the contractor when such procedures and equipment provide, as a minimum, the quality assurance required in the contractual documents. Prior to applying such alternative inspection procedures and inspection equipment, the contractor shall describe them in a written pro-	**4.9.2 In-process inspection and testing** The supplier shall a) inspect, test and identify product as required by the quality plan or documented procedures; b) establish product conformance to specified requirements by use of process monitoring and

posal and shall demonstrate for the approval of the Government Representative that their effectiveness is equal to or better than the contract quality assurance procedure. In cases of dispute as to whether certain procedures of the contractor's inspection system provide equal assurance, the procedures of this specification, the item specification and other contractual documents shall apply.	control methods; c) hold product until the required inspection and tests have been completed or necessary reports have been received and verified except when product is released under positive recall procedures (see 4.10.1). Release under positive recall procedures shall not preclude the activities outlined in 4.10.2a); d) identify nonconforming product.
No equivalency	**4.9.3 Final inspection and testing** The quality plan or documented procedures for final inspection and testing shall require that all specified inspection and tests, including those specified either on receipt of product or in-process, have been carried out and that the data meets specified requirements. The supplier shall carry out all final inspection and testing in accordance with the quality plan or documented procedures to complete the evidence of conformance of the finished product to the specified requirements. No product shall be despatched until all the activities specified in the quality plan or documented procedures have been satisfactorily completed and the associated data and documentation is available and authorized.

	4.9.4 Inspection and test records The supplier shall establish and maintain records which give evidence that the product has passed inspection and/or test with defined acceptance criteria (see 4.16).
3.3 Measuring and Test Equipment. The contractor shall provide and maintain gages and other measuring and testing devices necessary to assure that suppliers conform to technical requirements. In order to assure continued accuracy, these devices shall be calibrated at established intervals against certified standards which have kown valid relationships to national standards. If production tooling, such as jigs, fixtures, templates, and patterns is used as a media of inspection, such devices shall also be proved for accuracy at established intervals. Calibration of inspection equipment shall be in accordance with MIL-C-45662. When required, the contractor's measuring and testing equipment shall be made available for use by the Government Representative to determine conformance of product with contract requirements. In addition, if conditions warrant, contractor's personnel shall be made available for operation of such devices and for verification of their accuracy and condition.	**4.10 Inspection, measuring and test equipment** The supplier shall control, calibrate and maintain inspection, measuring and test equipment, whether owned by the supplier, on loan, or provided by the purchaser, to demonstrate the conformance of product to the specified requirements. Equipment shall be used in a manner which ensures that measurement uncertainty is known and is consistent with the required measurement capability. The supplier shall a) identify the measurements to be made, the accuracy required and select the appropriate inspection, measuring and test equipment; b) identify, calibrate and adjust all inspection, measuring and test equipment and devices that can affect product quality at prescribed intervals, or prior to use, against certified equipment having a known valid relationship to nationally recognized standards where no such standards exist, the basis used for calibration shall be documented; c) establish, document and maintain calibration procedures, including details of

		equipment type, identification number, location, frequency of checks, check method, acceptance criteria and the action to be taken when results are unsatisfactory; d) ensure that the inspection, measuring and test equipment is capable of the accuracy and precision necessary; e) identify inspection, meas-uring and test equipment with a suitable indicator or approved identification record to show the calibration status; f) maintain calibration records for inspection, measuring and test equipment (see 4.16); g) assess and document the validity of previous inspection and test results when inspection, measuring and test equipment is found to be out of calibration; h) ensure that the environmental conditions are suitable for the calibration, inspections, measurements and tests being carried out; i) insure that the handling, preservation and storage of inspection, measuring and test equipment is such that the accuracy and fitness for use is maintained; j) safeguard inspection, measuring and test facilities, including both test hardware and test software, from adjustments which would invalidate the calibration setting.

	Where test hardware (e.g. jigs, fixtures, templates, patterns) or test software is used as suitable forms of inspection, they shall be checked to prove that they are capable of verifying the acceptability of product prior to release for use during production and installation and shall be re-checked at prescribed intervals. The supplier shall establish the extent and frequency of such checks and shall maintain records as evidence of control (see 4.16). Measurement design data shall be made available, when required by the purchaser or his representative, for verification that it is functionally adequate.
3.5 Indication of Inspection Status. The contractor shall maintain a positive system for identifying the inspection status of products. Identification may be accomplished by means of stamps, tags, routing cards, move tickets, tote box cards or other control devices. Such controls shall be of a design distinctly different from Government inspection identification.	**4.11 Inspection and test status** The inspection and test status of product shall be identified by using markings, authorized stamps, tags, labels, routing cards, inspection records, test software, physical location or other suitable means, which indicate the conformance or nonconformance of product with regard to inspection and tests performed. The identification of inspection and test status shall be maintained, as necessary, throughout production and installation of the product to ensure that only product that has passed the required inspections and tests is dispatched, used or installed. Records shall identify the inspection authority responsible for the release of conforming product (see 4.16).

3.7 Nonconforming Material. The contractor shall establish and maintain an effective and positive system for controlling nonconforming material, including procedures for the identification, segregation, presentation and disposition of reworked or repaired supplies. Repair of nonconforming supplies shall be in accordance with documented procedures acceptable to the Government. The acceptance of nonconforming supplies is a prerogative of and shall be as prescribed by the Government. All nonconforming supplies shall be positively identified to prevent unauthorized use, shipment and intermingling with conforming supplies. Holding areas, mutually agreeable to the contractor and the Government Representative shall be provided by the contractor.	**4.12 Control of nonconforming product** The supplier shall establish and maintain procedures to ensure that product that does not conform to specified requirements is prevented from inadvertent use or installation. Control shall provide for identification, documentation, evluation, segregation (when practical), disposition of nonconforming product and for notification to the functions concerned. **4.12.1 Nonconfomity review and disposition** The responsibility for review and authority for the disposition of nonconforming product shall be defined. Nonconforming product shall be reviewed in accordance with documented procedures. It may be a) reworked to meet the specified requirements, or b) be accepted with or without repair by concession, or c) regraded for alternative applications, or d) rejected or scrapped. Where required by the contract, the proposed use or repair of product (see 4.13.1b) which does not conform to specified requirements shall be reported for concession to the purchaser or his representative. The description of nonconformity that has been accepted, and of

	repairs, shall be recorded to denote the actual condition. (see 4.16). Repaired and reworked product shall be reinspected in accordance with documented procedures.
No equivalency	**4.13 Corrective action** The supplier shall establish, document and maintain procedures for a) investigating the cause of nonconforming product and the corrective action needed to prevent recurrence; b) analysing all processes, work operations, concessions, quality records, service reports and customer complaints to detect and eliminate potential causes of nonconforming product; c) initiating preventive actions to deal with problems to a level corresponding to the risks encountered; d) applying controls to ensure that corrective actions are taken and that they are effective; e) implementing and recording changes in procedures resulting from corrective action.
No equivalency	**4.14 Handling, storage, packaging and delivery** **4.14.1 General** The supplier shall establish, document and maintain procedures for handling, storage, packaging and delivey of product.

	4.14.2 Handling The supplier shall provide methods and means of handling that prevent damage or deterioration. **4.14.3 Storage** The supplier shall provide secure storage areas or stock rooms to prevent damage or deterioration of product, pending use or delivery. Appropriate methods for authorizing receipt and the despatch to and from such areas shall be stipulated. In order to detect deterioration, the condition of product in stock shall be assessed at appropriate intervals. **4.14.4 Packaging** The supplier shall control packing, preservation and marking processes (including materials used) to the extent necessary to ensure conformance to specified requirements and shall identify, preserve and segregate all product from the time of receipt until the supplier's responsibility ceases. **4.14.5 Delivery** The supplier shall arrange for the protection of the quality of product after final inspect-ion and test. Where contractually specified, this protection shall be extended to include delivery to destination.
3.2.2 Records. The contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observ-	**4.15 Quality Records** The supplier shall establish and maintain procedures for identification, collection,

ations made, the number and type of deficiencies found, the quantities approved and rejected and the nature of corrective action taken as appropriate. **3.2.3 Corrective Action.** The contractor shall take prompt action to correct assignable conditions which have resulted or could result in the submission to the Government of supplies and services which do not conform to (1) the quality assurance provisions of the item specification, (2) inspections and tests required by the contract, and (3) other inspections and tests required to substantiate product conformance. **3.2.4 Drawings and Changes.** The contractor's inspection system shall provide for procedures which will assure that the latest applicalbe drawings, specifications and instructions required by the contract, as well as authorized changes thereto, are used for fabrication, inspection and testing.	indexing, filing, storage, maintenance and disposition of quality records. Quality records shall be maintained to demonstrate achievement of the required quality and the effective operation of the quality system. Pertinent subcontractor quality records shall be an element of these data. All quality records shall be legible and identifiable to the product involved. Quality records shall be stored and maintained in such a way that they are readily retrievable in facilities that provide a suitable environment to minimize deterioration or damage and to prevent loss. Retention times of quality records shall be established and recorded. Where agreed contractually, quality records shall be made available for evaluation by the purchaser or his representative for an agreed period.
No equivalency	**4.17 Training** The supplier shall establish and maintain procedures for identifying the training needs and provide for the training of all personnel activities affecting quality during production and installation. Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and/or experience, as required. Appropriate records of training shall be maintained (see 4.15).

3.9 Sampling Inspection. Sampling inspection procedures used by the contractor to determine quality conformance of supplies shall be as stated in the contract or shall be subject to approval by the Government.	**4.18 Statistical techniques** Where appropriate, the supplier shall establish procedures for identifying adequate statistical techniques required for verifying the acceptability of process capability and product characteristics.
No equivalancy	**4.17 Internal quality audits** The supplier shall carry out a comprehensive system of planned and documented internal quality audits to verify whether quality activities comply with planned arrangements and to determine the effectiveness of the quality system. Audits shall be scheduled on the basis of the status and importance of the activity. The audits and follow-up actions shall be carried out in accordance with documented procedures. The results of the audits shall be documented and brought to the attention of the personnel having responsibility in the area audited. The management personnel responsible for the area sahll take timely corrective action on the deficiencies found by the audit (see 4.1.3).
3.8 Qualified Products. This inclusion of a product on the Qualified Products List only signifies that at one time the manufacturer made a product which met specification requirements. It does not relieve the contractor of his responsibility for furnishing supplies that meet all specification requirements for such material.	No equivalency

3.11 Government Inspection at Subcontractor or Vendor Facilities. The Government reserves the right to inspect at souce supplies or services not manufactured or performed within the contractor's facility. Government inspection shall not constitute acceptance; nor shall it in any way replace contractor inpsection or otherwise relieve the contractor of his responsibility to furnish an acceptable end item. When inspection at subcontract-ors'plants is performed by the Government, such inspection shall not be used by contractors as evidence of effective inspection by such subcontract-ors. The purpose of this inspection is to assist the Government Representative at the contractor's facility to deter-mine the conformance of supplies or services with contract requirements. Such inspection can only be requested by or under authorization of the Government Representative.	No equivalency
3.11.1 Government Inspection Requirements. When Government inspection is required, the contractor shall add to his pur-chasing document the following statement: "Government inspection is required prior to ship-ment from your plant. Upon receipt of this order, promptly notify the Gov-ernment Representative who normally services your plant so that appropriate planning for Government inspection can be accomplished."	No equivalency

3.13 Government Evaluation. The contractor's inspection system and supplies generated by the system shall be subject to evaluation and verification inspection by the Government Representative to determine its effectiveness in supporting the quality requirements established in the detail specifications, drawings and contract and as prescribed herein.	No equivalency

APPENDIX D

MIL-Q-9858A/ISO MATRIX

MIL-Q-9858	9001	9002	9003	9004
1.1, 1.2	N/A	N/A	N/A	1
1.3	4.2	4.2	4.2	5
2	N/A	N/A	N/A	N/A
3.1	4.1.2.1	4.1.2.1	4.1.2.1	4, 5.5, 5.2.3
3.2	4.3	4.3	N/A	5.3.3, 8.3, 8.25
3.3	4.9.1	4.8.1	N/A	11.3, 17.2
3.4	4.16	4.15	4.4, 4.6	5.3.4, 17.3
3.5	4.14	4.13	N/A	15
3.6	N/A	N/A	N/A	4.3.2, 6
4.1	4.5	4.4	4.3	17.2
4.2	4.11	4.10	4.6	13
4.3	4.11	4.10	N/A	N/A
4.4	4.11	4.10	N/A	N/A
4.5	4.2	4.2	N/A	N/A
5.1	4.6	4.5	N/A	9
5.2	4.6.3	4.5.3	N/A	9.5
6.1	4.10	4.9	N/A	11.2, 12.1
6.2	4.9	4.8	N/A	10, 12.2
6.3	4.10.3	4.9.3	4.5	12.3
6.4	4.15	4.14	4.9	16
6.5	4.13	4.12	4.8	14
6.6	4.20	4.18	4.12	20
6.7	4.12	4.11	4.7	11.7
7.1	N/A	N/A	N/A	N/A
7.2	4.7	4.6	N/A	N/A
8	N/A	N/A	N/A	1

LIST OF REFERENCES

1. Davis, T., "Benchmarking Total Quality; European and International Standards for Quality," paper presented at the Global Perspectives on Total Quality Seminar, Sollentuna, Sweden, 28-31 May 1990.

2. British Standards, Quality Systems, BS5750:Part 0, *Guide to Quality Management and Quality System Elements*, 1987.

3. British Standards, Quality Systems, BS5750:Part 1, *Specification for Design/Development, Production, Installation and Servicing*, 1987.

4. British Standards, Quality Systems, BS5750:Part 2, *Specification for Production and Installation*, 1987.

5. British Standards, Quality Systems, BS5750:Part 3, *Specification for Final Inspection and Test*, 1987.

6. Bell, W.R., *Contracting with NATO Industry: U.S. or Foreign Procurement Regulations?*, Master's Thesis, Naval Postgraduate School, Monterey, California, September 1981.

7. Marvel, K.B., "Global Competition: The Time is NOW!" *Contract Management*, pp. 4-13, May 1991.

8. Assistant Secretary of Defense (Production and Logistics), Memorandum for Under Secretary of the Army, Subject: *ISO Quality Assurance Standards, 9000 Series*, 7 August 1989.

9. Epstein, I.J., "Quality Assurance Standards," brief presented by Assistant Director International Quality Assurance, Office, Secretary of Defense.

10. U.S. Department of Commerce, National Institute of Standards and Technology, Standards Code and Information Program, Office of Standards Service, *Questions and Answers on Quality, the ISO 9000 Standard Series, Quality System Registration and Related Issues*, Government Printing Office, Washington, DC, November 1991.

11. Defense Contract Management District - Northeast, Training brief given by Mr. Magnun to Quality Assurance Representatives, November 1991.

12. Marquardt, D., and others, "Vision 2000 - A Strategy for International Standards Implementation in the Quality Arena during the 1990s," *EOQ Quality*, pp.23-37, February 1991.

13. Department of Defense, Briefing conducted at the 23rd Annual Industry/Government Liaison Meeting held at Danvers, Mass., Subject: *ISO 9000 Panel*, 31 October 1991.

14. Quality Systems Update, *Directory of ISO 9000 Registered Companies*, CEEM Publications, Fairfax, VA, February 1992.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2.	Defense Logistics Studies Information Exchange U.S. Army Logistics Management Center Fort Lee, Virginia 23801	1
3.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
4.	Dr. D. V. Lamm, Code AS/Lt Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	2
5.	Dr. Stephen Zirschky, Code AS/Zi Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	2
6.	CDR Rodney F. Matsushima, SC,USN,Ret. 2243 Casemont Drive Falls Church, Virginia 22046	2
7.	LCDR Stanley M. Beckerdite 204 W. Staggerbush Lane Beverly Hills, Florida 32661	2
8.	Curricular Officer, Code AS Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	1